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INTERNATIONAL CIVIL AVIATION ORGANIZATION

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ICAO WRC-27 Preparatory Workshop

Agenda item AI 1.13:
Direct Satellite Connectivity for IMT.
Impact on aeronautical systems[1]

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Workshop on ITU World Radiocommunication Conference 2027
(WRC-27 Workshop)
Dakkar, Senegal, 02-03 March 2026

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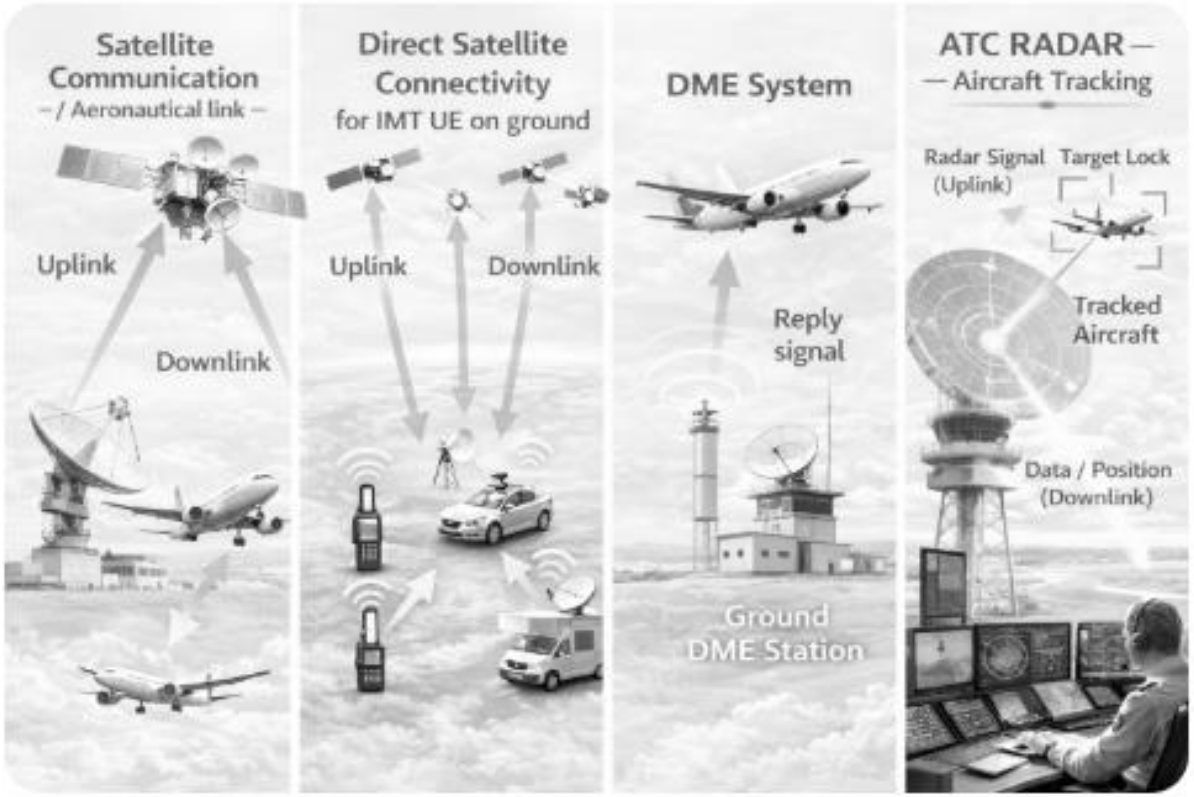
1: Based on Annex 8 to WP4C Document [528], *Report of the thirty-fourth meeting of Working Party 4C* (Geneva, 15–24 October 2025), and the related United States studies contribution for WP4C.).https://www.itu.int/md/R23-WP4C-C-0528/en

Presentation Overview[1]



01 **Background**

02 **Impact on ARNS and AMS systems**

03 **ICAO Position**

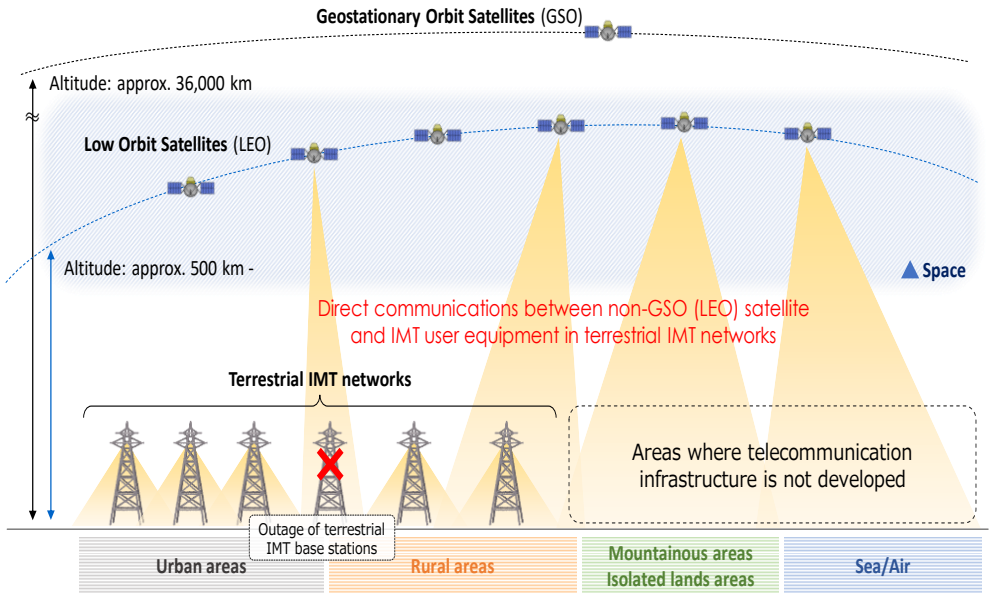
04 **Conclusion**

1: Based on Annex 8 to WP4C Document [528], *Report of the thirty-fourth meeting of Working Party 4C* (Geneva, 15–24 October 2025), and the related **United States studies contribution** for WP4C.).https://www.itu.int/md/R23-WP4C-C-0528/en

Resolution 253 (WRC-23).

resolves to invite the ITU Radiocommunication Sector to complete in time for the 2027 world radiocommunication conference

1 studies on possible allocations to the MSS in the frequency range between 694/698 MHz and 2.7 GHz, taking into account the IMT frequency arrangements addressed in the most recent version of Recommendation ITU R M.1036;



Potential impact on aviation

Mobile station transmitter (MHz)	Base station transmitter (MHz)	ICAO spectrum	ICAO use
698-748	753-803		
698-716 776-798	716-746 746-768		
832-862	791-821		
880-915	925-960		
		960 – 1 164	(ACAS), automatic dependent surveillance – broadcast (ADS-B), (DME), (LDACS), multilateration (MLAT) (SSR) & (UAT)
		1 164 – 1 215	Distance Measuring Equipment (DME) & global navigation satellite systems (GNSS)
		1 215 – 1 300	Global navigation satellite systems (GNSS) & primary surveillance radar
1 427-1 470	1 475-1 518		
		1 525 – 1 559	Satellite communication
		1 559 – 1 626.5	Global navigation satellite systems (GNSS)
		1 610 – 1 626.5	Satellite communication
		1 626.5 –1 660.5	Satellite communication
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		
2010-2025	1880-1920		
2 305-2 320	2 345-2 360		
2 500-2 570	2 620-2 690		
		2 700 – 2 900	Primary surveillance and weather radar

- BS total spectrum : 630 MHz; Mobile total spectrum : 593 MHz => BS + Mobile spectrum: 1 223 MHz
- **Report ITU-R M.2077-0:** Shortfall of spectrum for the satellite component of IMT and systems beyond IMT-2000 of > 144 MHz (s-E) and > 19 MHz (E-s).
- DC-MSS-IMT uses existing IMT user equipment (UEs). Studies should focus only on the downlink (space-to-Earth / network-to-device) operation.

Compatibility between DC-MSS-IMT (s-E) in 925-960 and ARNS in 960–1 215 MHz (DME system) / AM(R)S in 960–1 164 MHz (LDACS)

Non-GSO System: DC-MSS-IMT (s-E) configurations for direct connectivity to IMT UE in 925-960 MHz

DC-MSS-IMT (s-E)	Constellation 1	Constellation 2
Altitude (km)	525	340
Inclination (deg)	53	53
# Planes	28	48
Sats per plane	120	110
RAAN spacing (deg)	12.857	7.5
Typical bandwidth (MHz)	5	5 MHz
Polarization	RHCP	RHCP
PFD on ground per sat (dBW/m²/MHz)	–93.4	–92.4
Total number of sats	3 360	5 280

DME and LDACS protection levels

Parameters	DME airborne	LDACS ground
Frequency center, MHz	962	964
Receiver noise figure, dB	4	6
Thermal noise density, dBW/MHz	-144	-144
Cable loss, dB	4	2
Max antenna gain, dBi	5.4	12
Protection criteria[1], I/N, dB	-10	-6
Protection level at antenna input, dBW/MHz	-151.4	-154
dBW/MHz to dbW/m²/MHz	21.1	21.1
Max power flux density, dBW/m²/MHz	-130.3	-132.8

How the study is run (method + assumptions)

Geometry and sampling

- Uses **14 "representative" U.S. airports**
- Evaluates interference at:
  - **Ground (airport surface)** for LDACS, and
  - **Aircraft at 13 716 m** for DME airborne.
- Simulation:
  - **24 hours**
  - **30-second time step**
  - **Elevation mask = 0**

Assumptions for modeling interference (as stated)

- Satellites are assumed **always active** (each satellite communicates "all the time" on its channel).
- **7 channels × 5 MHz** exist in 925–960 MHz;
- channels are **randomly assigned** across satellites (so only a fraction are co-channel at a time).
- **Free-space path loss** is used (justified by high aircraft altitude and "sub-urban airports with low obstacles").
- Uses **out-of-band emissions (OOBE) EIRP density**.

Summary of Compatibility study results between DC-MSS-IMT (s-E) in 925-960 MHz and ARNS/AMS in 960-1 164 MHz

Results (no mitigation)

	Constellation 1		Constellation 2	
	DME airborne	LDACS ground	DME airborne	LDACS ground
Max aggregate PFDs (dBW/m²/MHz)	−118.5	−120	−116.7	−117
Max power flux density, dBW/m²/MHz	−130.3	−132.8	−130.3	−132.8
Margin dB	−11.8	−12.8	−13.6	−15.8

Compatibility is **not achieved** under these assumptions**.**

Results (Mitigation applied)

Restrict DC-MSS-IMT downlink operation to **925–955 MHz** (i.e., **remove 955–960 MHz** from use)

	Constellation 1		Constellation 2	
	DME airborne	LDACS ground	DME airborne	LDACS ground
Max aggregate PFDs (dBW/m²/MHz)	−136.5	−136.7	−133.7	−134.2
Max power flux density, dBW/m²/MHz	−130.3	−132.8	−130.3	−132.8
Margin dB	+6.2	+3.9	+3.4	+1.4

Conclusion (mitigated): Under the same modeling choices, limiting DC-MSS-IMT to **925–955 MHz** yields **compliance** with the LDACS and DME adjacent-band PFD limits, with **small-to-moderate positive margins**.

Compatibility between DC-MSS-IMT in 1 475–1 518 MHz and MSS (space-to-Earth) SatCom receivers in 1 525–1 559 MHz

Protection levels of AMS(R)S receivers in 1 525-1 559 MHz

Parameters	AMS(R)S High gain	AMS(R)S Low gain
Frequency centre, MHz	1 525.1	1 525.1
AMSS earth station (G/T), dB/K	-13	-20
Max antenna gain, dBi	12	6
Rx Noise PSD, dbW/Hz	-203.6	-202.6
Protection criteria, I/N, dB	-12.22	-12.22
Protection level at antenna input, dBW/MHz	-167.8	-160.8
dBW/MHz to dbW/m^2/MHz	25.1	25.1
Max power flux-density, dBW/m^2/MHz	-142.7	-135.7

- Same Non-GSO System : DC-MSS-IMT (s-E) configurations for direct connectivity to IMT UE in 1 475-1 518 MHz
- Same method and assumptions
- Same Assumptions for modeling interference

Summary of the compatibility study results between DC-MSS-IMT (s-E) in 1 475-1 518 MHz and AMS(R)S satcom receivers in 1 525-1 559 MHz

Results (no mitigation)

	Constellation 1	Constellation 2
Max aggregate PFD (dBW/m^2/MHz)	-132.5	-130.3
AMS(R)S Satcom PFD limit (dBW/m^2/MHz) (low gain/high gain)	-135.7 / -142.7	-135.7 / -142.7
Margin (dB)	-3.2 / -10.2	-5.4 / -12.4

Results (Mitigation applied)

Restrict DC-MSS-IMT downlink operation to **1 475-1 513 MHz** (i.e., **remove 1 513 –1 518 MHz** from use)

	Constellation 1	Constellation 2
Max aggregate PFD (dBW/m^2/MHz)	-138.6	-136.1
AMS(R)S Satcom PFD limit (dBW/m^2/MHz) (low gain/high gain)	-135.7 / -142.7	-135.7 / -142.7
Margin (dB)	+2.9 / -4.1	+0.4 / -6.6

Conclusion (mitigated): no exceedance for low gain; exceedance for high gain.

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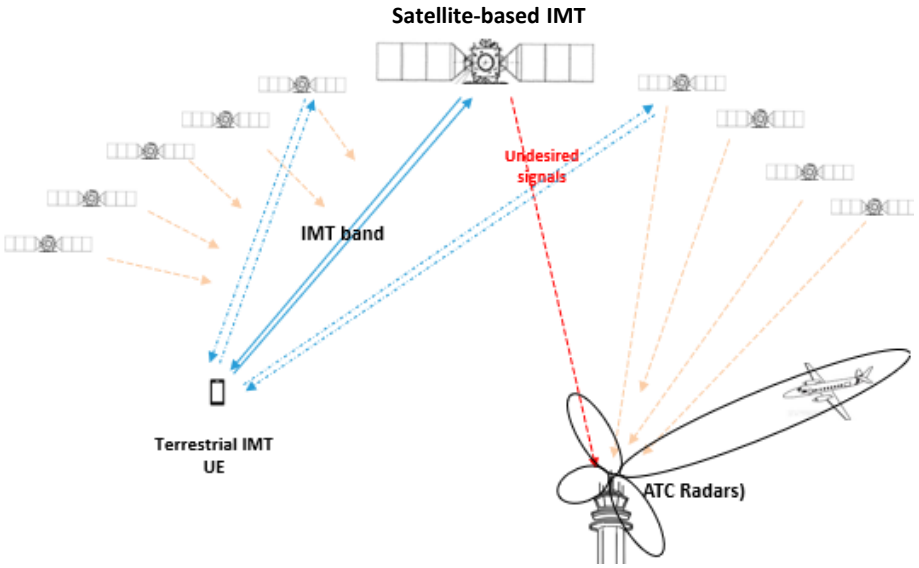
Compatibility between DC-MSS-IMT (s-E) in 2 620-2 690 MHz and ARNS in 2 700-2 900 MHz (ATC Radar)

NGSO System: DC-MSS-IMT configurations for direct connectivity to IMT UE in 2 620-2 690 MHz

- Same configuration in slide 5

Protection levels of the ARNS radar C operating in 2 700-2 900 MHz

Parameters	Radar C
Frequency center, MHz	2 700.5
Receiver noise figure, dB	3.3
Thermal noise density, dBW/MHz	-144
Antenna gain (main/side/back lobe), dBi	34 / 6.1 / -2.5
Protection criteria, I/N, dB	-10
Protection level at antenna input, dBW/MHz	-184.7 / -156.8 / -148.2
dBW/MHz to dbW/m²/MHz	30.1
Max power flux density, dBW/m²/MHz	-154.6 / -126.7 / -118.1



Use OOBE EIRP to determine the DC-MSS-IMT (s-E) interference

The aggregate PFD downlink within 2620–2690 MHz at the considered ground point was calculated at each time step (30 secs) of the simulation by summing the PFD contributions of all satellites participating in the link at that time.

The maximum aggregate PFD corresponds to the highest value of this time series of aggregate PFDs over the entire simulation period (e.g., approximately 24 hours).

Compatibility study results between DC-MSS-IMT (s-E) in 2 620-2 690 MHz and ARNS radars in 2 700-2 900 MHz

Margin results__Nominal case

	Constellation 1	Constellation 2
Max aggregate PFD (dBW/m²/MHz)	-129.1	-126.4
ARNS radar PFD limit (dBW/m²/MHz) (main/side/back lobes)	-154.6 / -126.7 / -118.1	-154.6 / -126.7 / -118.1
Margin (dB)	-25.5 / +2.4 / +11	-28.2 / **-0.3** / +8.3

Margin results__Mitigation case

Restrict DC-MSS-IMT downlink operation to **in 2 620-2 685 MHz** (i.e., **remove 2685-2690 –1 518 MHz** from use)

	Constellation 1	Constellation 2
Max aggregate PFD (dBW/m²/MHz)	-133.8	-131.3
AMS(R)S Satcom PFD limit (dBW/m²/MHz) (low gain/high gain)	-154.6 / -126.7 / -118.1	-154.6 / -126.7 / -118.1
Margin (dB)	-20.8 / +7.1 / +15.7	-23.3 / +4.6 / +13.2

ICAO position

For **WRC-27 Agenda Item 1.13** (direct satellite connectivity to IMT phones), **ICAO's published position** is essentially https://www.icao.int/sites/default/files/FSMP/065e.pdf :

- **Oppose** any new MSS allocations or regulatory actions under Resolution 253 (WRC-23) that overlap frequencies used by civil aviation within 694–2 700 MHz.
- **Ensure** that outcomes for bands adjacent to aeronautical systems operating within 694–2 700 MHz:
  - do **not reduce protection** for civil aviation systems operating in parts of 694–2 700 MHz, and
  - do **not impose additional regulatory or technical constraints** on those civil aviation systems, including primary surveillance and weather radars adjacent to the upper end of the 694–2 700 MHz range.

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Conclusion

Studies in 925–960 MHz, 1 475–1 518 MHz and 2 620–2 690 MHz indicate that, under aggregate, worst-case assumptions, full-band DC-MSS-IMT downlink operation may not ensure compatibility with incumbent aeronautical systems operating in adjacent bands.

While band-edge restrictions can improve outcomes in some cases, residual impacts may remain, notably for high-gain aeronautical SatCom receivers (1 525–1 559 MHz) and ATC radar (2 700–2 900 MHz), particularly under main-beam.

Accordingly, any regulatory action should preserve aeronautical safety-of-life protection, require demonstration under aggregate/worst-case conditions, and ensure mitigations are practicable, enforceable, and do not constrain aviation operations.

Thank You

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