



International spectrum management for Earth observation and meteorology

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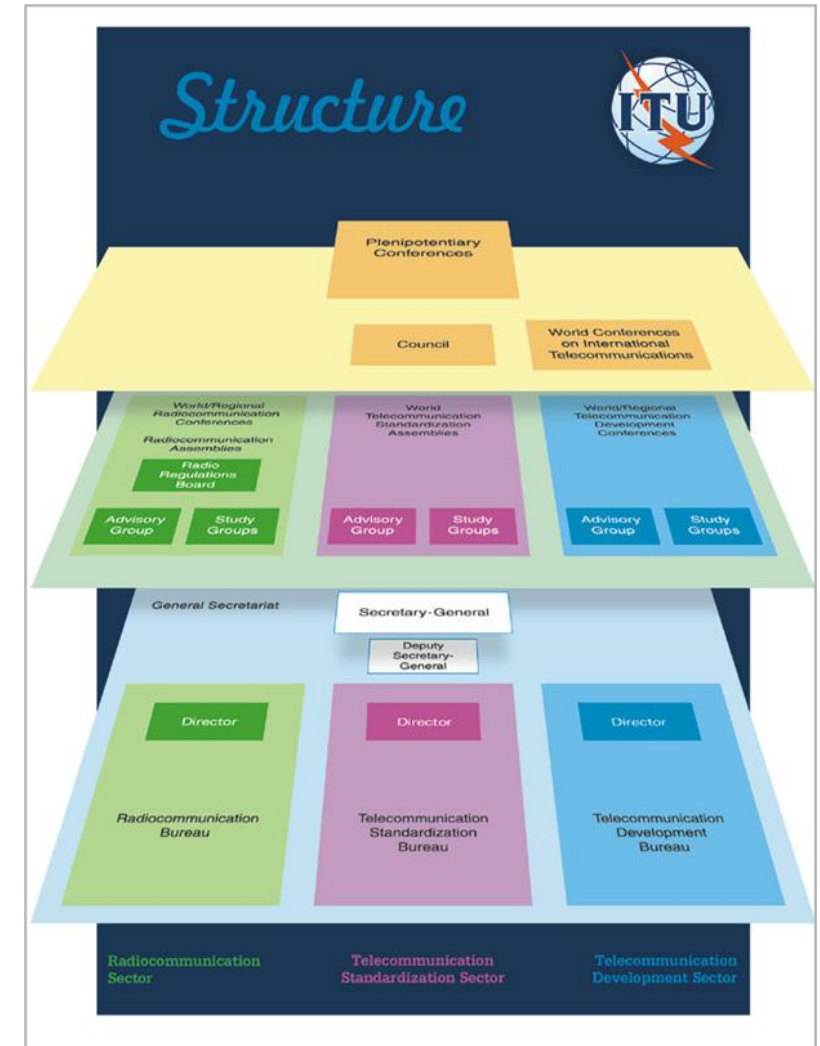
Global ITU/WMO Seminar

Spectrum use for meteorology: challenges, opportunities and evolving requirements

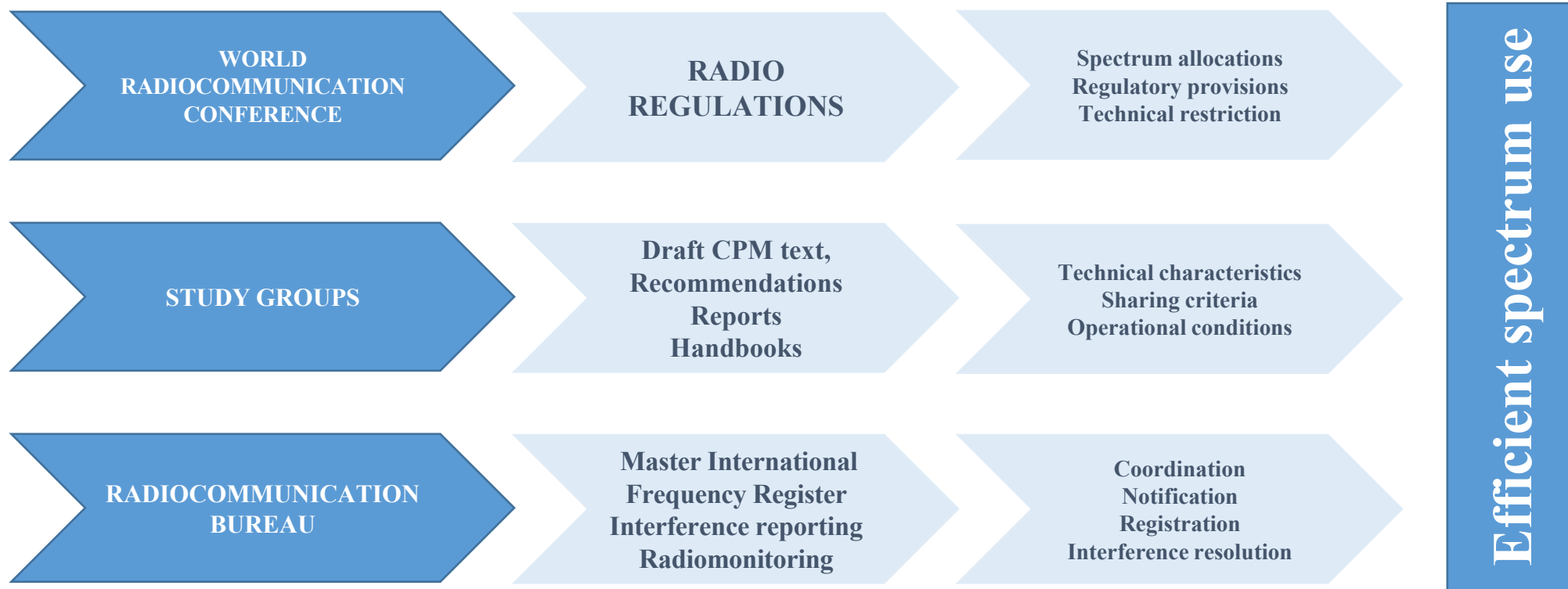
28-30 September 2026, Geneva, Switzerland

ITU – UN specialised agency

- Since 1865
- Since 1947 UN agency
- 194 Member States
- 1 000 Sector Members
- 100 Academia
- Three Sectors:
Radiocommunication,
Telecommunication Standardization,
Development



ITU-R: Radiocommunication Sector



Radio Regulations

Status

- Mandatory intergovernmental treaty

Concept

- Make spectrum and orbital positions allocations in order to avoid harmful interference between radio stations of different countries

Main instruments

- Allocation – Entry in the Table of Frequency Allocations for the purpose of its use by one or more terrestrial or space radiocommunication services under specified conditions.
- Radiocommunication service – A service as defined in this section involving the transmission, emission and/or reception of radio waves for specific telecommunication purposes

RR Article 5

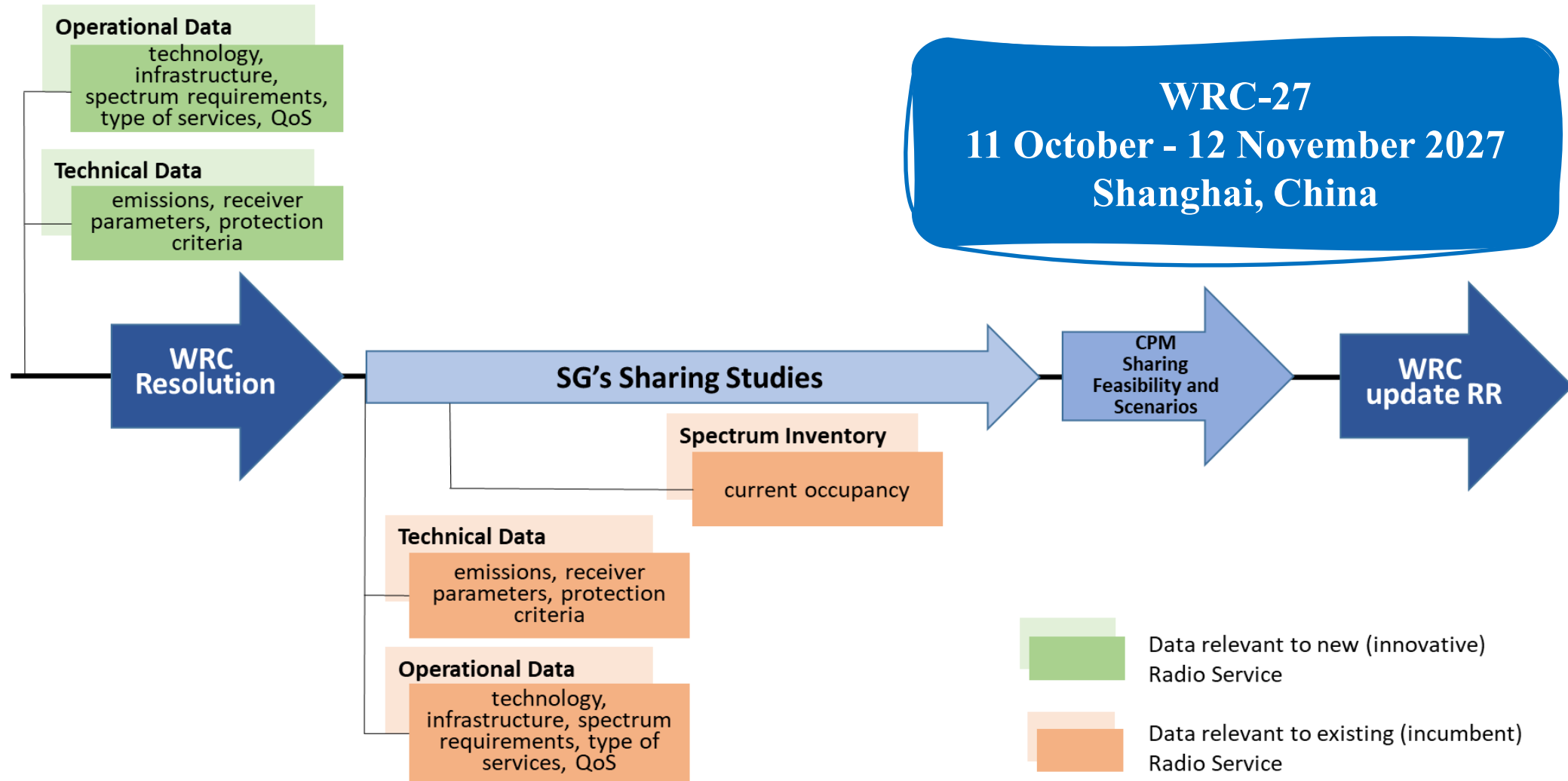
335.4-410 MHz

Allocation to services		
Region 1	Region 2	Region 3
402-403	METEOROLOGICAL AIDS EARTH EXPLORATION-SATELLITE (Earth-to-space) METEOROLOGICAL-SATELLITE (Earth-to-space) Fixed Mobile except aeronautical mobile 5.264A 5.264B	

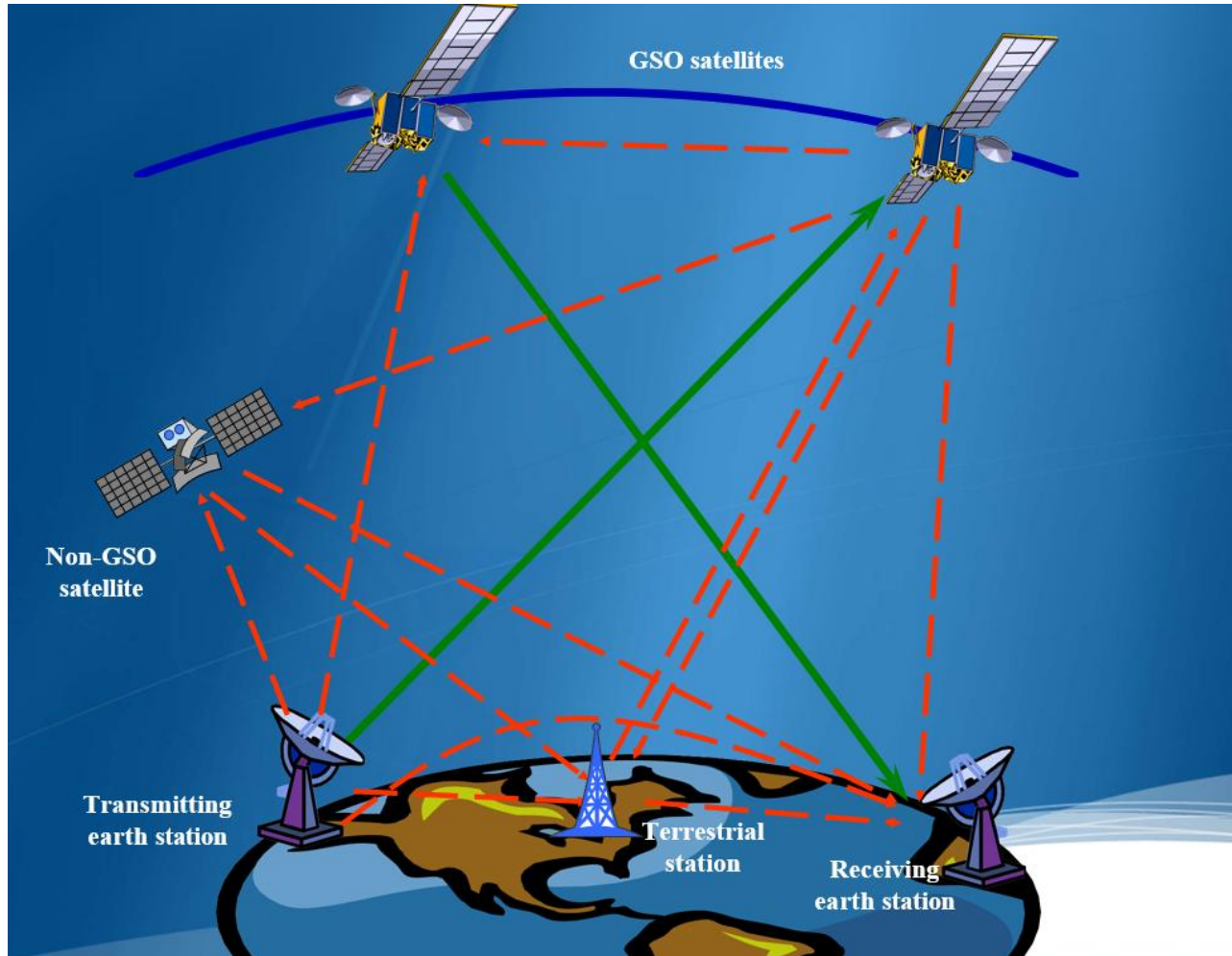
RR No. 5.340 – All emissions are prohibited

1 400-1 427 MHz	31.5-31.8 GHz	100-102 GHz	182-185 GHz
2 690-2 700 MHz	48.94-49.04 GHz	109.5-111.8 GHz	190-191.8 GHz
10.68-10.7 GHz	50.2-50.4 GHz	114.25-116 GHz	200-209 GHz
15.35-15.4 GHz	52.6-54.25 GHz	148.5-151.5 GHz	226-231.5 GHz
23.6-24 GHz	86-92 GHz	164-167 GHz	250-252 GHz
31.3-31.5 GHz			

WRC (international spectrum allocations) process



Interference



Interference free operation



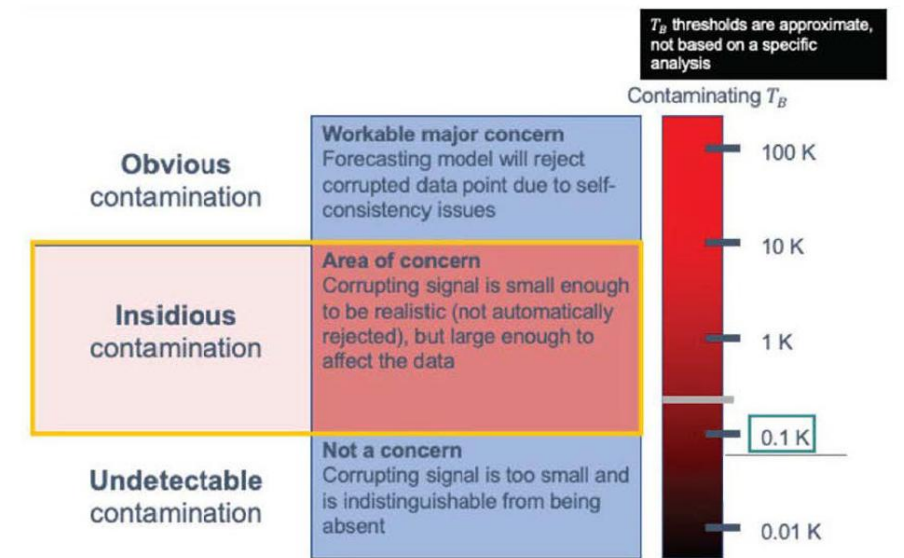
Harmful interference-effect of unwanted energy due to emission upon reception, manifested in any performance degradation



Spectrum sharing conditions

Interference

- **Degradation of Quality of Service**
- Some new radio technologies are more sensitive to interference or more interference aggressive than traditional systems —**out of service umbrella**
- **Late-comer costs** – increasing *CAPEX* (bigger antenna size, restricted parameters, more expensive equipment, shielding, specialised software) and *OPEX* (more qualified staff, advanced signal processing methods, more power, coordination requirements) —**uncertainty of investments**
- Growing challenges in ensuring compliance with RR requirements, resulting in increased **potential of RFI**

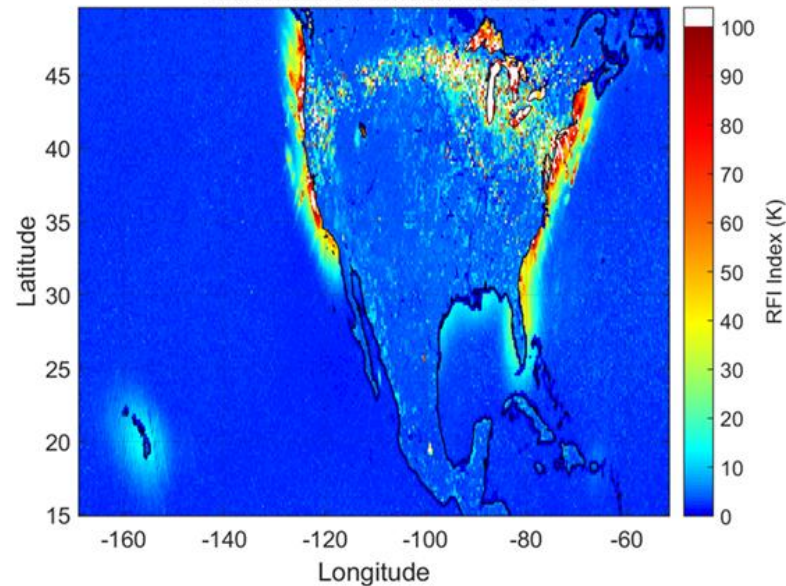


Source: Testimony by David Lubar to U.S. House of Representatives; Hearing of the Science, Space & Technology Committee, July 2021.

Interference

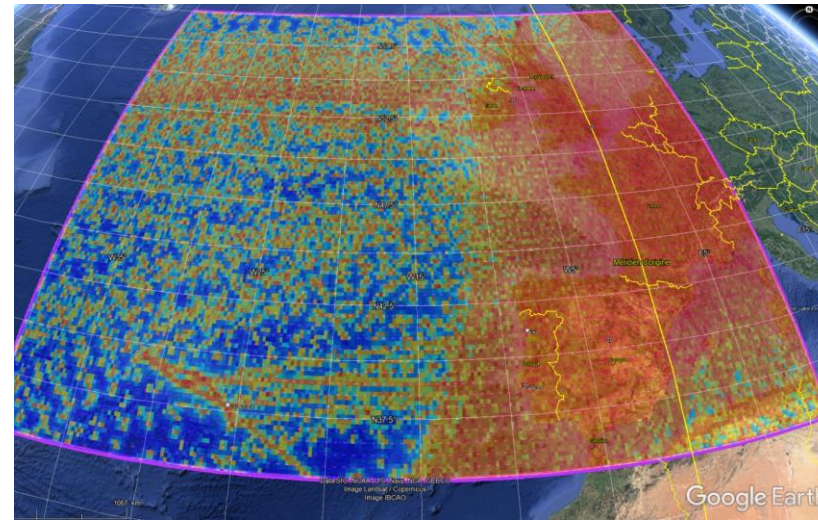
New interference scenarios

Maximum RFI Index 18GHz

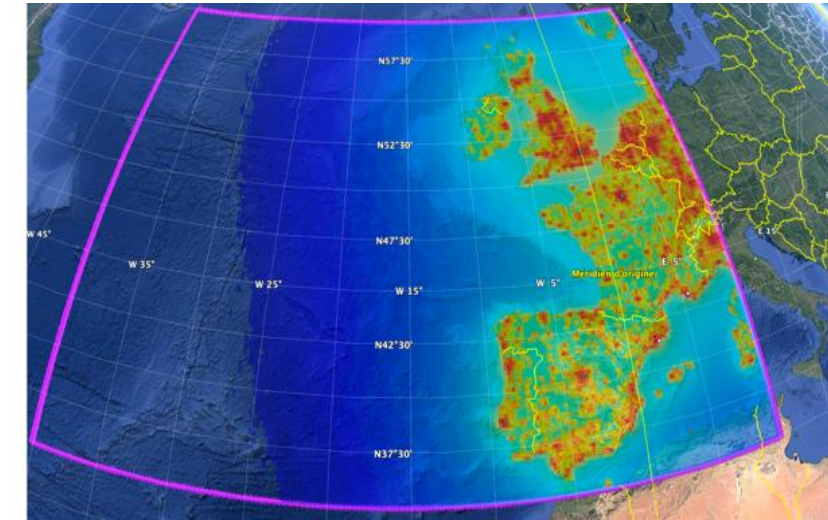


Reflection (18.6-18.8 GHz)
Water vapour profile,
precipitation, clouds, snow,
ice, sea surface wind

New radio applications



WAIC (4 200-4 400 MHz)
Sea surface temperature

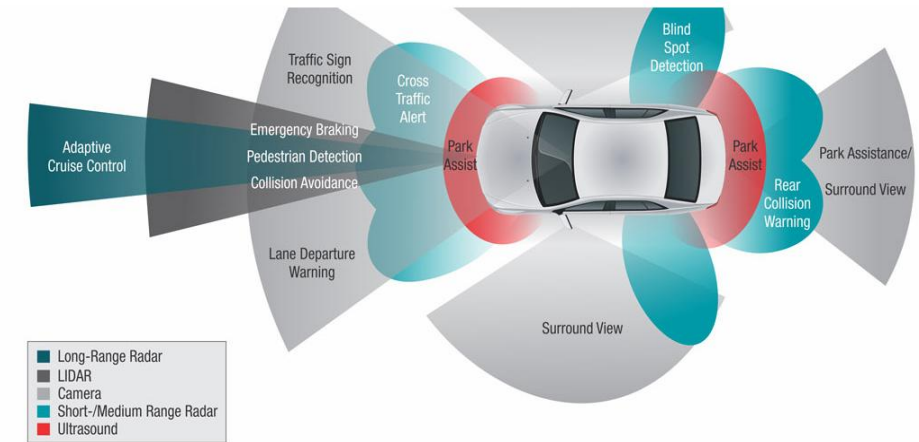


IMT (6425-7 250 MHz)
Sea surface temperature

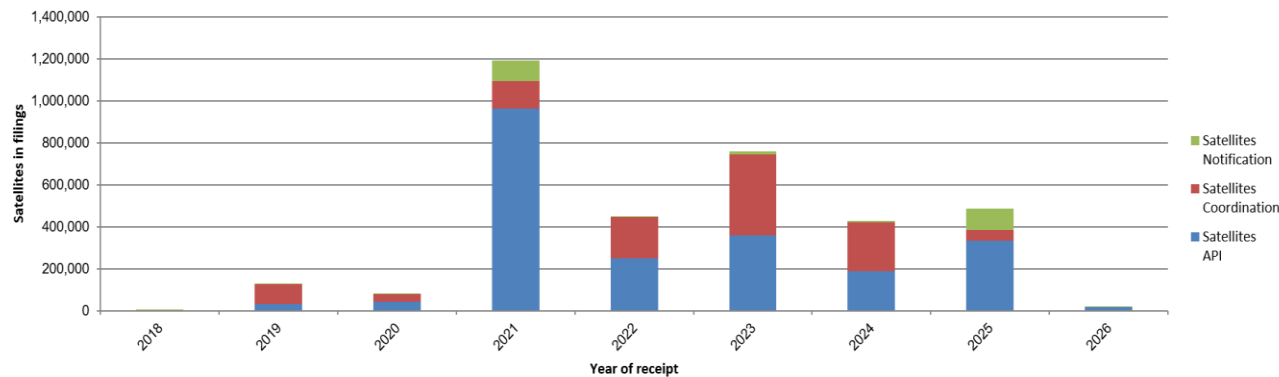
Spectrum demand

IMT Family History

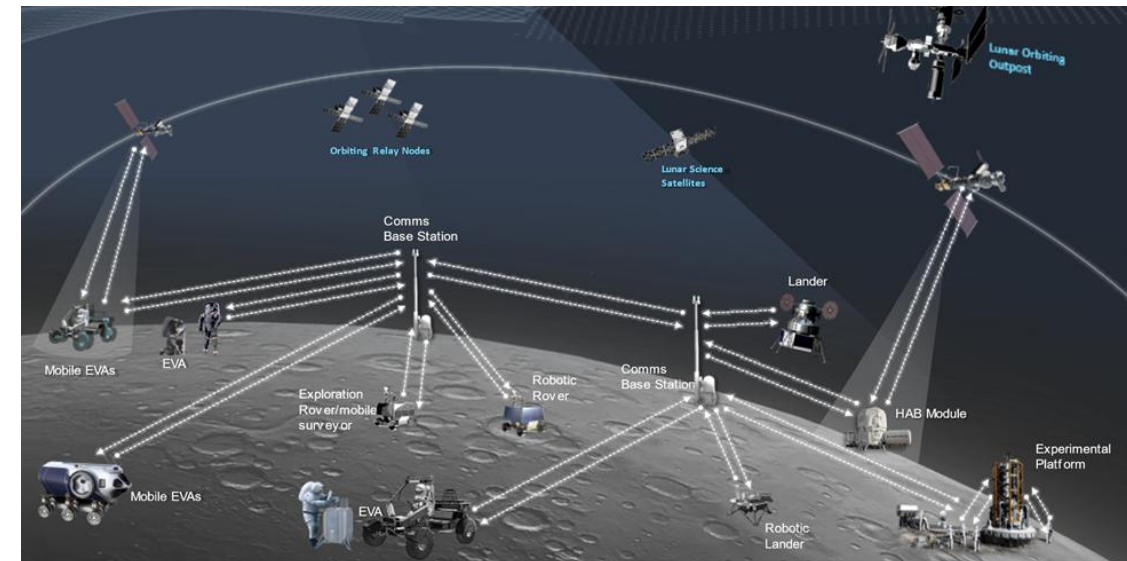
		IMT-2000 (3G)	IMT-Advanced (4G)	IMT-2020 (5G)	IMT-2030 (6G)
Report (FTT)	Future Tech Trends (FTT)	-	-	Rep. ITU-R M.2320	Rep. ITU-R M.2516
		-	-	Nov 2014	Nov 2022
Recommendation (Vision/Framework)	Vision	Rec. ITU-R M.687 & M.816	Rec. ITU-R M.1645	Rec. ITU-R M.2083	Rec. ITU-R M.2160
		Feb/Mar 1992 → 1997	June 2003	September 2015	November 2023
Reports (Requirements, evaluation methodology and submission template)	Technical Performance Requirements	Rec. ITU-R M.1034	Rep. ITU-R M.2134	Rep. ITU-R M.2410	Future work
		Feb 1997	2008	2017	
	Submission Template	8/LCCE/47 + Add	Rep. ITU-R M.2133	Rep. ITU-R M.2411	
		1998	2008	2017	
Evaluation Methodology	Evaluation Methodology	Rec. ITU-R M.1225	Rep. ITU-R M.2135-1	Rep. ITU-R M.2412	
		Feb 1997	2009	2017	
Recommendation (Radio Interface Tech.)	RIT Specifications (1 st release)	Rec. ITU-R M.1457	Rec. ITU-R M.2012	Rec. ITU-R M.2150	
		May 2000	Jan 2012	Feb 2021	



Filed NGSO satellites per year by stage (2005-2026)



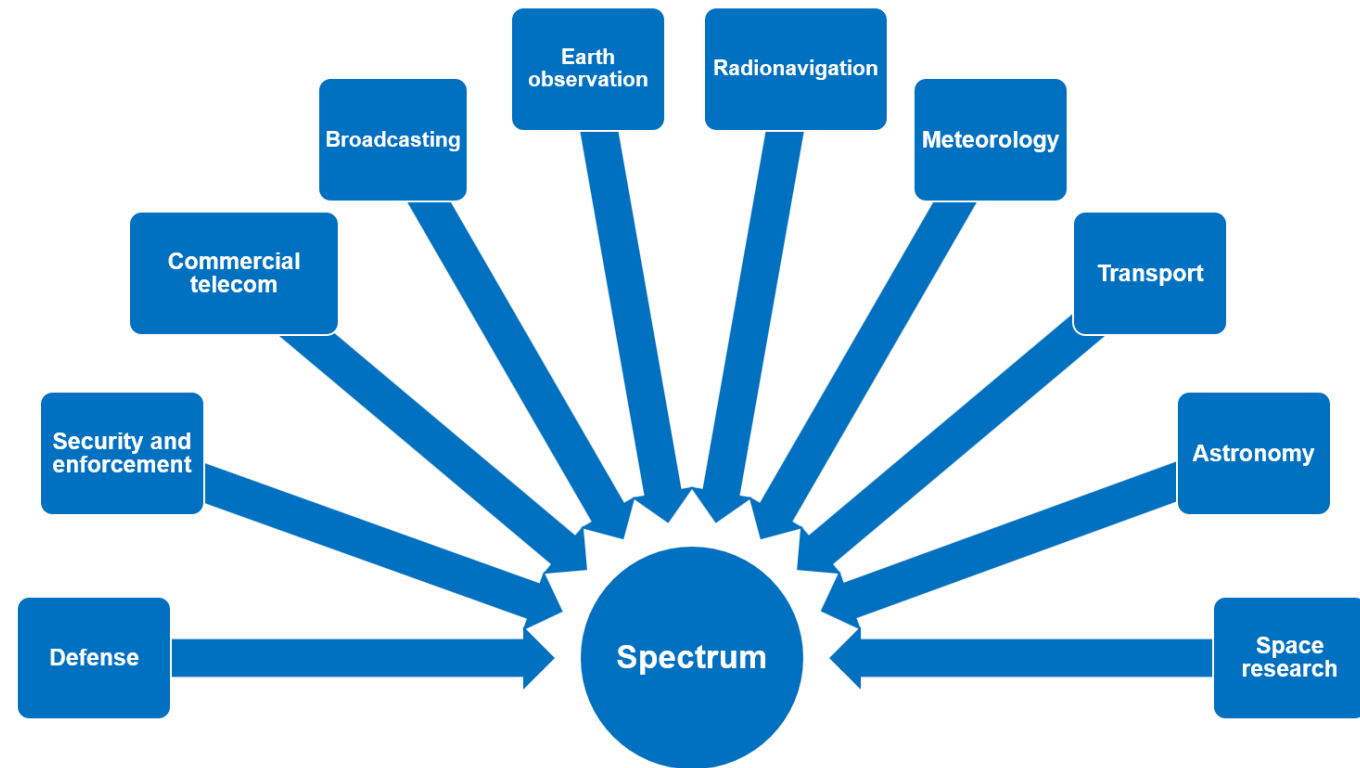
	Filings API	Filings Coordination	Filings Notification	Filings Total	Satellites API	Satellites Coordination	Satellites Notification	Satellites sum across stages
Total	1,985	543	720	3,248	2,181,472	1,137,448	226,025	3,544,945



Spectrum dilemma: spectrum scarcity

“In using frequency bands for radio services, Member States shall bear in mind that radio frequency and any associated orbits are limited natural resources and that they must be used rationally, efficiently and economically”

ITU Constitution, Article 44



Spectrum value

What can we gain (economic value)?		What can we avoid losing (public value)?	
<i>Spectrum use</i>	<i>Estimated outcome</i>	<i>Spectrum use</i>	<i>Estimated outcome</i>
IMT spectrum rights	US\$81.2 billion (USA, 2021) 280 MHz in the 3.7–3.98 GHz band	Meteorological observations	>1,200 lives saved annually (USA)
Mobile technologies and services	US\$7.6 trillion (2025) Global; 6.4% of global GDP	Advanced vehicle safety measures	24,794 fatalities and 140,740 serious casualties prevented (EU)
LEO satellite communications	Global potential annual contribution US\$14.8 billion (2026)	Earth observation	Savings of €1.25 billion per year potential lost due to declined productivity (EU)
Earth observation	Global potential annual contribution up to US\$703 billion/year	Earth observation	US\$2.56 billion savings per year in the electricity and gas consumption (USA)

Are there also constraints that need to be taken into account?

Protection of the radio spectrum for meteorology and Earth observation is essential to ensure that public investments translate into real-world benefits — social development, human well-being, safety and health, and the basic conditions of life: shelter, clean water and air, and food security.