

Improvement of spectrum management system

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Spectrum use

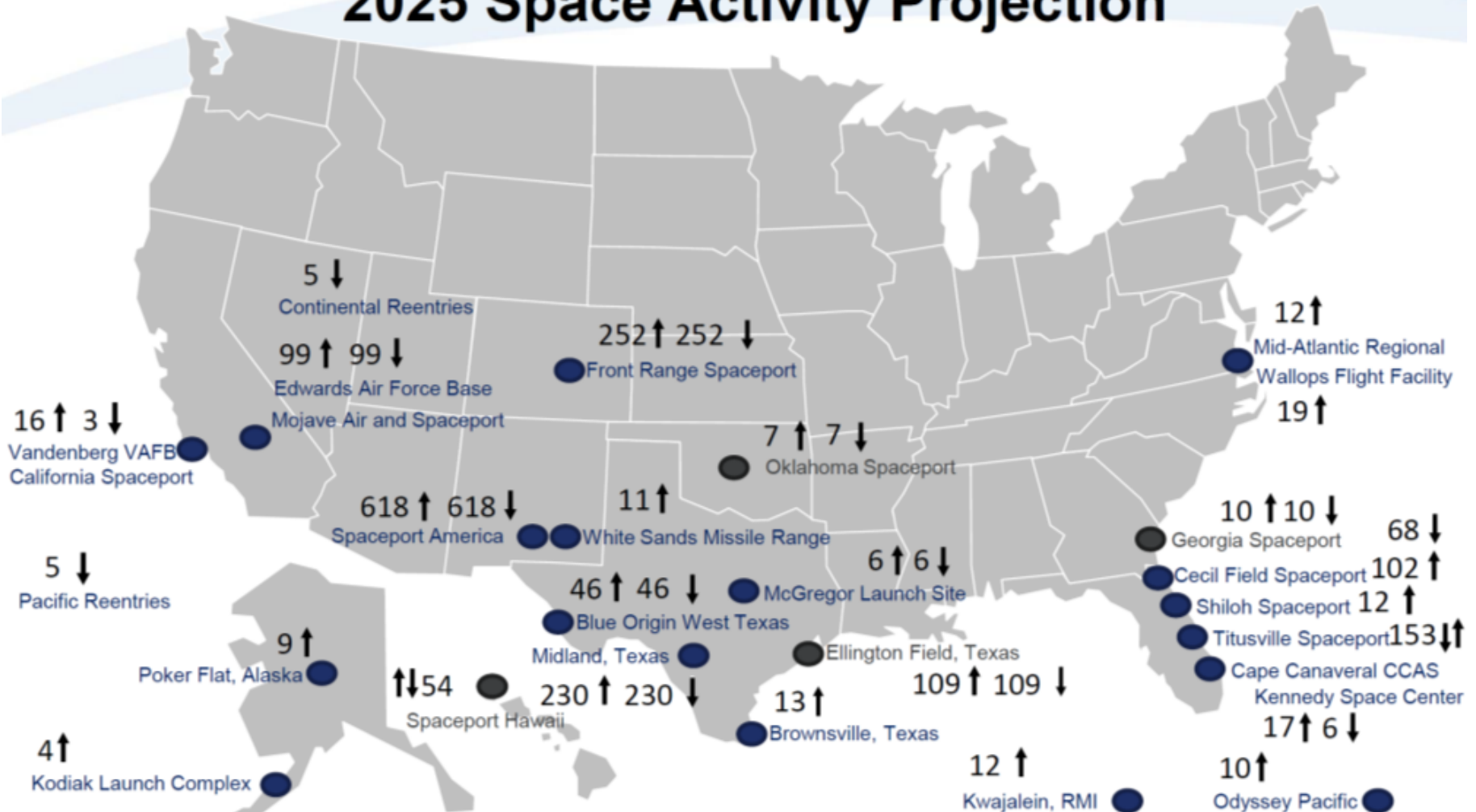
Main user(s)	Radio systems used	Functional uses	End use output	Intersectoral use output	Digital economy programmes
Defence	Mobile and satellite communication systems, radio-relay links, location systems, radars	Operational control of all armed forces, operation of air defence and aerospace forces	Safeguarding national security	Development of radio-electronic industries and science	e-defence
Security and law-enforcement agencies	Mobile and satellite communication systems, Radio-relay systems	Operational control of subordinate units	Maintenance of internal security and law enforcement, government communications	Development of radio-electronic industries and science	e-security
Communications and informatization	Mobile and satellite communication systems, radio-relay systems, sensor systems	Provision of access to data transmission systems and public communication networks	Public communication and informatization services, maintenance of economic security	Development of radio-electronic industries and trade, social development	e-government e-education e-medicine e-democracy
Broadcasting	Satellite and radio-relay communication systems, broadcasting networks	Broadcasting of TV and radio programmes	Safeguarding freedom of thought, speech and public information	Development of commerce, advertising, public information	e-culture e-elections e-education
Earth Exploration	Remote Earth sensing satellites	Collection of data on the state of the Earth's natural characteristics	Cartography, geoinformation, data on the state of the climate and natural resources	Construction, extraction of natural resources	e-democracy
Radionavigation	Satellite and land-based navigation systems	Transmission of precise time and location signals	Precise determination of the location and speed of objects	Development of all branches of industry	e-democracy, e-defence e-security
Meteorology and Earth monitoring	Remote earth sensing and data collection satellites, radars, meteorology probes and sensors	Collection of meteorological data	Weather forecasting, prediction of natural disasters. Monitoring of climate change	Maintenance of defence, transport, agriculture and forestry, green energy production	e-climate e-democracy e-agriculture
Transport	Mobile and satellite communication and navigation systems, sensors, radars	Remote monitoring and control of transport, broadband access	Protection of human life, improving safety of passenger and cargo transport, optimization of traffic, driverless transport	Development of trade, the hotel and tourism sector, postal services	e-navigation, e-safety e-roads e-commerce
Radio astronomy	Ground and space radio astronomy stations	Collection of data on the cosmos	Development of fundamental science	Development of all branches of industry	e-science
Space research	International Space Station, piloted and pilotless space missions	Studies on the near-Earth space environment and space objects	Development of fundamental science, search for natural resources, protection from potential hazards from space	Development of all branches of industry	e-science, e-industry
Industrial production enterprises	Office and corporate networks, control/management, automation and quality-control networks	Improving production efficiency and safety	Optimizing use of resources	Development of all branches of industry	e-industry

Spectrum demand

Service	Total spectrum allocation in Region 1 below 1 GHz, MHz	Demand for spectrum use until 2023
Mobile service	8 800	Strong
Fixed service	62 000	Strong
Fixed-satellite service	34 900	Strong
Mobile-satellite service	17 900	Medium
Broadcasting-satellite service	5 600	No change
Earth exploration-satellite and meteorological-satellite service	22 300	Medium
Broadcasting service	5 400	Falling
Maritime services	180	Strong
Aeronautical services	581	Strong
Total	157 700	—

Spectrum limits

2025 Space Activity Projection

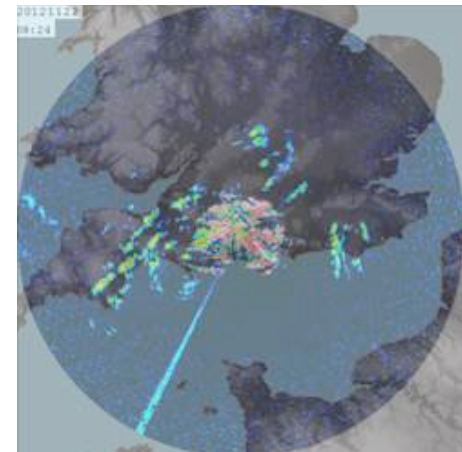
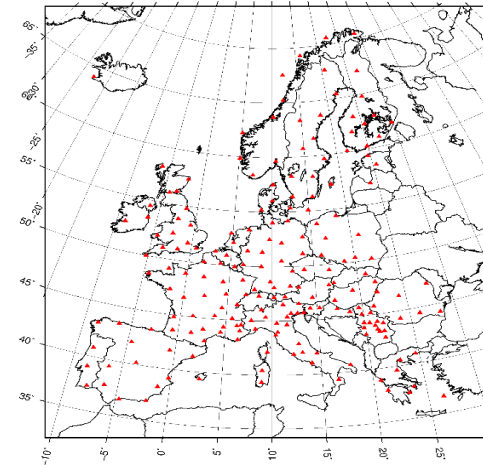


Spectrum management challenges

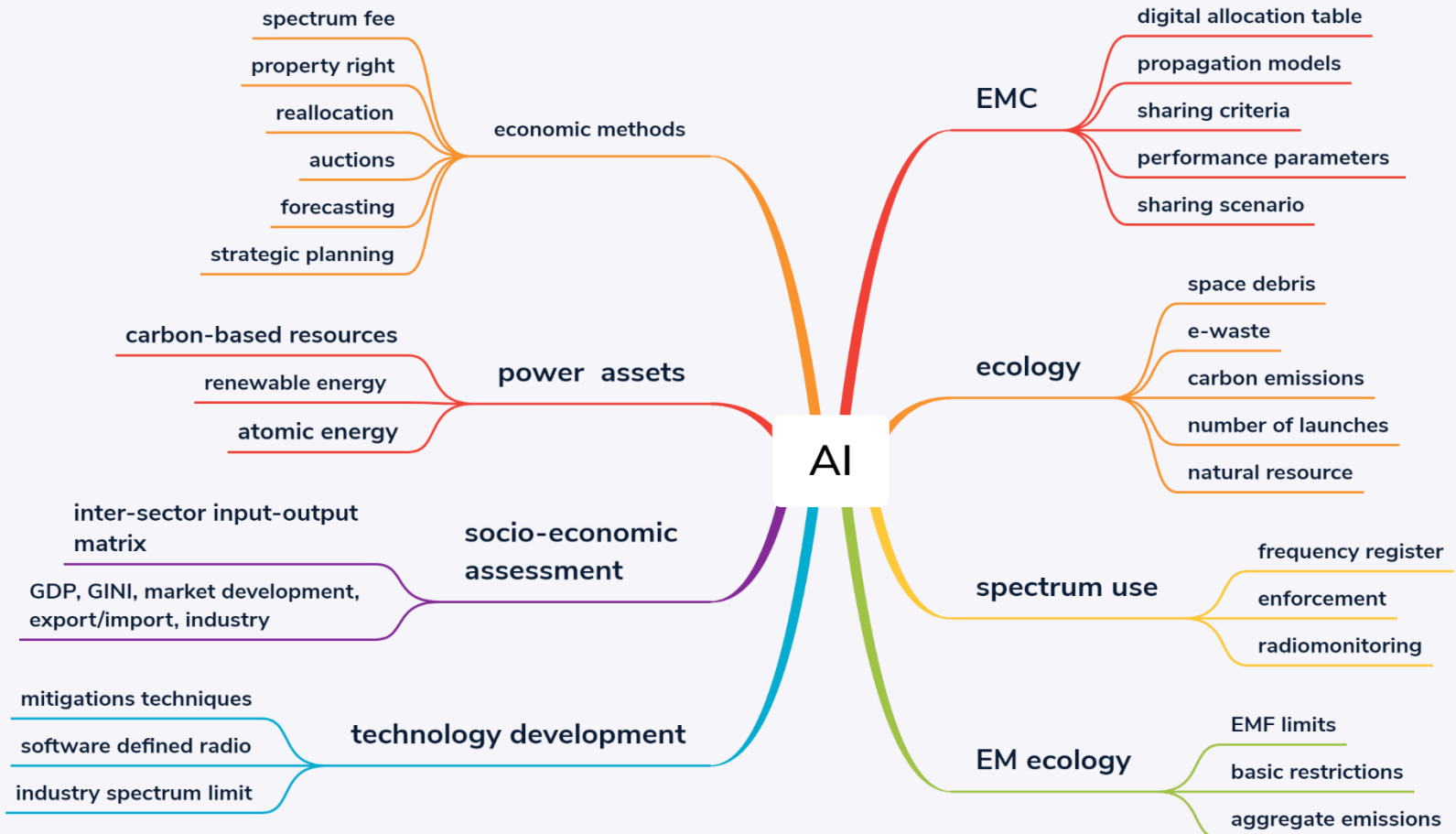
- **Spectrum scarcity (WRC-19 \geq 30 new A.I)**
- **New merged technologies**
- **New applications (HAPS for IMT base station, sub-orbital vehicles, space weather global monitoring etc.)**
- **No real picture of spectrum occupation - interference reporting, recording in MIFR**
- **Obsolete procedures**
- **Political influence**

Illegal spectrum use- interference case study (RLAN-meteo radars)

Starting	2006
Current status	180 existing radars only in EC (average CAPEX 1 million Euros per site)
Scale of degradation	110 radars in 21 EU States, up to thousands cases per site, 5600-5650 MHz band
Applications	the conditions of the atmosphere, severe weather detection for navigation, wind and precipitation detection and estimates, detection of aircraft icing conditions
Type approval	RTTE Directive (Self approval)
Market surveillance campaign <i>(ECC REPORT 192)</i>	64 different 5 GHz WAS/WLAN devices 38 samples: DFS function could be directly or indirectly deactivated 3 samples: DFS does not exist



E-spectrum



Input-output matrix for spectrum use

		Main spectrum users				Aggregate bandwidth for k scenario	Socio-economic impact		Overall impact for k -th scenario	Overall cost for k -th scenario
		1	2	...	n		Output for end-user for k -th scenario	Inter-sector output for k -th scenario		
Spectrum allocation scenarios	1	s_{11}	s_{12}	...	s_{1n}	S_1	y_{int1}	y_{ext1}	Y_1	W_1
	2	s_{21}	s_{22}	...	s_{2n}	S_2	y_{int2}	y_{ext2}	Y_2	W_2

	k	s_{n1}	s_2	...	s_{nk}	S_k	y_{intk}	y_{extk}	Y_k	W_k
Revenue		p_1	p_2	...	p_n					
Capital cost		cap_1	cap_2	...	cap_n					
Operational costs		op_1	op_2	...	op_n					
Spectrum use costs		w_1	w_2	...	w_n					

$$e_n = y_n/w_n = y_n/cap_n(s_{nk}) + op_n(s_{nk}) + p_n$$

Thank you