Frequencies for radars

Groupement des Industries Françaises
Aéronautiques et Spatiales

GIFAS

Sector situation

Stakes

Radar systems provide location information and imagery for a wide variety of societal applications. The majority of radars are used for the safety of human life, as they have the advantage of being fast, efficient, compact and can run all the time (whatever the weather conditions), day and night. They have also the ability to range, that is to say, "see," for very long distances of up to several thousand kilometres. Radar services are found in systems of several major areas, such as:

- Air transport monitoring **(civil air traffic control, homeland security)** including over maritime areas;
- Space surveillance **(trajectory of objects in orbit, ballistic missile warning)**;
- Defence **(airborne, land and naval systems, detection, tracking, driving shots)**;
- Navigation **(shipping, aerospace tracking)**;
- Anti-collision **(aircraft in flight and on the ground, automobile, drones)**;
- Meteorology, Oceanography, imaging of soil and oceans **(airborne, space)**;
- Metrology **(flight testing, industrial processes)**.

Social and economic importance

The radar sector contributes greatly to the development of society and economic prosperity. It brings real-time knowledge for better efficiency, whether in the optimisation of transport (air, sea, land), or the safety of property and people. For example:

- Military radars allow States to monitor and defend their territory;
- Civil air traffic control radars allow the safe transport of more than 4 billion passengers and 65 million tons of cargo per year, with an annual growth in traffic of +5% over 2019-2040 period;
- Weather radars are used to track weather patterns, contribute to the prediction of rainfall and the prevention of natural disasters;
- Maritime and coastal radars secure global trade by cargo freight;
- Imaging radars enable the comprehensive compilation of inventories (geography, vegetation, housing, infrastructure, climate) and environmental prevention actions.

From the perspective of the economic impact, according to Data Bridge Market Research, the global market of this sector exceeds $43 billion in 2024 and is expected to reach $68 billion by 2032.

Specificities

In operational terms, only radar sensors have the ability to instantly monitor wide sky and sea areas by itself. Without this primary capacity to monitor airspace, security would not be sufficient to allow planes to fly, particularly around airports.

Transportation systems require a high degree of security, such as civil aviation and maritime, and require special protection of frequencies against unwanted interference phenomena.

Furthermore, radars are involved in the safety of the inhabitants of a country as they detect intruders in the national airspace, which is also an important and, unfortunately, growing task in the face of terrorism and global geopolitical instability.

National security requires the use of robust radar detection means, independent of cooperative systems, which may exist for commercial purposes.

Technically, the performance of radars is intrinsically linked to the propagation of electromagnetic waves in the atmosphere and their reflection on objects. Therefore, frequencies used by radar systems are dependent on each intended application.

The majority of radar systems emit pulsed waves or, sometimes, continuous waves on one or more frequency bands necessary to function correctly. Radars use antennas and highly sensitive radio receivers to measure very weak echoes returned by the detected objects, and after extensive propagation losses related to the back and forth paths of the radio signal. Radar can easily be affected, therefore, by adjacent frequency bands emissions of less sensitive radio systems.

The amount of RF spectrum used by a radar is closely linked to its mission. For example, the increasing need for high-resolution imaging requires an increase of the spectral bands used by radars. Similarly, military radars use jumping techniques between different possible frequencies to resist opponents, requiring a sufficient amount of available spectrum.

The main frequency bands used by radars are:

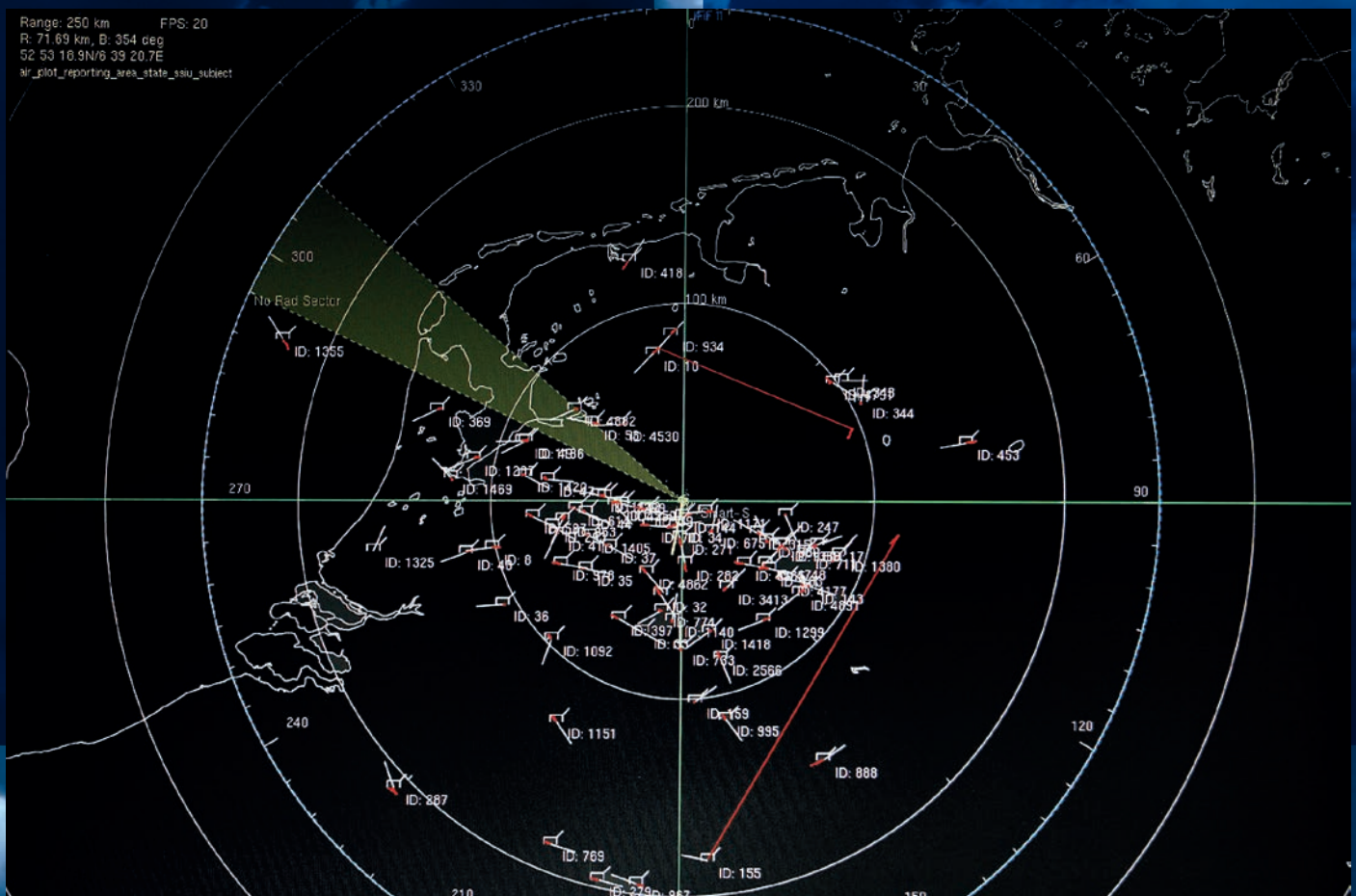
- **Few bands below 300 MHz;**
- **430-440 MHz, 1215-1400 MHz, 2700-3400 MHz;**
- **5250-5850 MHz, 8500-12000 MHz, 15.4-17.3 GHz, 33.4-36.0 GHz;**
- **59.0-64.0 GHz, 76-81 GHz, 92-100 GHz.**

Evolution: an industry viewpoint

The globalisation of trade and mass tourism generate a long-term increase in air traffic. Media coverage of accidents, saturation of airports, and environmental impact are important topics which enhance existing requirements or define new ones. Flight safety and optimisation of flight plans require the use of radars providing primary information for air traffic control and in-situ knowledge of the actual weather conditions.

Furthermore, the global geopolitical instability and new forms of terrorism require air surveillance assets to be strengthened, more efficient and adapted to new missions. Primary radars are important tools for this role, and spectrum access restriction would have significant impact in this area.

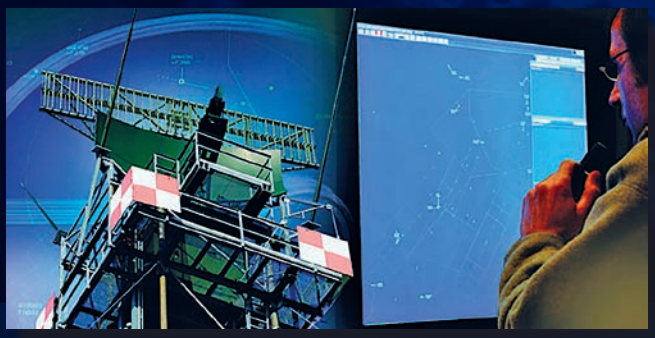
To meet the growing needs outlined earlier, new radar systems are currently under consideration and require continuity of bands dedicated to the radiolocation and radio navigation.



Spectrum requirements

Many radar systems are currently operating worldwide. This requires the availability of spectrum to perform different kinds of applications, such as:

- **Bands below 300 MHz:** Space objects surveillance, oceanography;
- **430-440 MHz:** Air surveillance of small objects;
- **1300-1350 MHz:** Air Traffic Control (mainly en-route);
- **1215-1400 MHz:** Sea and Air Surveillance for Territorial Defence;
- **2700-2900 MHz:** Air Traffic Control (mainly during Airport Approach), Meteorology;
- **2700-3400 MHz:** Sea and Air surveillance for Territorial Defence, Maritime navigation;
- **5250-5850 MHz:** Sea and Air surveillance, Meteorology, Spaceborne imagery;
- **8500-12000 MHz:** Air Traffic Control, Meteorology, Sea and Air Surveillance for Territorial Defence, all-weather and very long-range airborne imaging;
- **15.4-17.3 GHz, 33.4-36 GHz:** Anti-Air Defence, and medium and short-range airborne imaging;
- **76-81 GHz, 92-100 GHz:** Short range applications (i.e. Automotive radar, Aircraft taxiing).



Pending the results of on-going studies, e.g. aircraft approach landing, wind wake vortex, anti-collision radar, improvement of resolution..., new allocations may be required.

Moreover, under pressure from the needs of mobile telephony, numerous studies are being conducted on the inventory of frequency bands uses and possible sharing with various radar systems. Several technical studies show the difficulty of finding solutions in sharing the same band between mobile systems and radars. Interference between adjacent bands should also be carefully considered.

The industry is aware of the scarcity of radio spectrum, has the will to implement the most modern techniques to optimise the spectrum, but research advances slowly in this mature industry after more than 100 years of existence. Therefore, the growth of the radar sector needs to be extremely careful before releasing spectrum allocated to radiolocation and radio navigation services.

As an example, under the agenda item 1.2 of the World Radiocommunications Conference 2023, some countries authorized International Mobile Telecommunications (IMT) in radar bands. ITU reports indicate a high risk of disruption between IMT and radar services. The development of IMT in radars band will therefore affect the performances of existing and future radar systems.

In addition, possible studies may be launched after 2027 on the use of Airborne radar X-band frequencies for other purposes, and on the use of radar S-band frequencies for Earth exploration satellite services.

About GIFAS

GIFAS is a Trade Association with 517 members, from major prime contractors and system suppliers to small specialist companies. They cover the full spectrum of skills from the design, development and production of aerospace systems to marketing, maintenance and operation. GIFAS members are active in all sectors of the aerospace industry including civil and military aircraft, helicopters, engines, missiles and weapons, satellites and launch systems, UAV, large aerospace, defence and security systems, equipment, subassemblies and associated software applications. Managed through dedicated entities, GIFAS structures its recommendations in the spectrum domain through the Frequencies Commission.

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