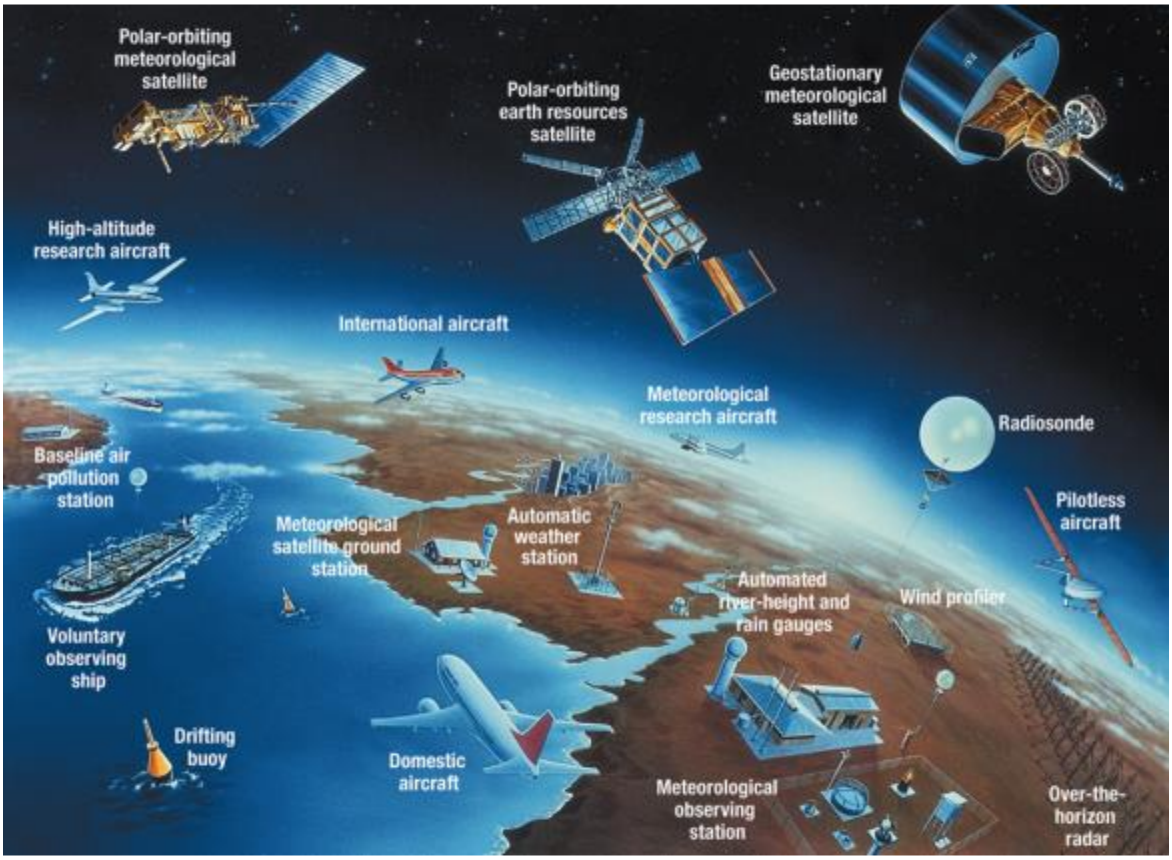
Bureau of Meteorology Submission to the Australian Communications and Media Authority (ACMA)

Draft Five-year spectrum outlook 2024–29 (FYSO)

April 2024



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1. About the Bureau of Meteorology

The Bureau of Meteorology (the Bureau) is Australia's national weather, climate and water agency, providing a wide range of products and services to support informed decision-making by governments, emergency services, industry and the community.

The Bureau operates under the authority of the *Meteorology Act 1955* (Cth) and the *Water Act 2007* (Cth), which together provide the legal basis for its activities. The Bureau must also fulfil Australia's international obligations under the Convention of the World Meteorological Organization (WMO) and related international meteorological treaties and agreements.

The Bureau is an Executive Agency under the *Public Service Act 1999* (Cth), and a non-corporate Commonwealth entity under the *Public Governance, Performance and Accountability Act 2013* (Cth). The Bureau operates under the Climate Change, Energy, the Environment and Water portfolio and reports to the Minister for the Environment and Water generally, and to the Minister for Emergency Management on emergency management matters.

The Bureau's products and services include a range of observations, forecasts, warnings, analyses and advice covering Australia's atmosphere, water, ocean and space environments. Its expertise and services assist Australians to manage and live safely and productively within their natural environment.

The Bureau welcomes the opportunity to provide feedback to the *Draft Five-year spectrum outlook 2024–29*, and to work with ACMA on optimising the use of the radiofrequency spectrum for the benefit of the Australian community.

2. The Bureau's use of spectrum

The Bureau is the third-largest frequency spectrum user in Australia, with licenced frequency spectrum from below1 MHz to above 200 GHz to support a range of observing systems including active and passive sensors, fixed and mobile systems, and terrestrial to satellite services.

To meet the requirements of the different sectors of the meteorological services, reliable access to the radio frequency spectrum is critical for all Bureau sensors and communication links. The Bureau asks ACMA to consider the following recommendations in its five-year spectrum outlook (FYSO) plan.

2.1. Review of Spectrum licence technical framework at 2.5 GHz band

The Bureau relies on weather radars to produce accurate and reliable observations, even in extreme weather conditions. In this regard, long-range, dual polarized radars in the Bureau's fleet are those operating in S-band (2700−2900 MHz). An extensive number of these radars are already operational that are distributed around the country specifically in areas with high possibility of harsh weather environment. Australia operates the largest number of weather radars per capita in the world that shows the extensive investment by Australia for the public safety.

Enabling this network of S-band radars to provide their full operational features for the weather prediction and now casting, effective co-existence with other spectrum users including 2500 MHz Mobile services transmitters (2500−2570 MHz and 2620−2690 MHz) is a mandatory requirement. It should be noted that in some cases, the two systems are only few hundred meters apart.

To ensure an interference-free, co-existence between two adjacent systems, the Bureau believes that review of Spectrum Licence Technical Framework (SLTF) for 2.5 GHz band needs to be included in the current work plan of FYSO 2024-2029. While this topic was in the consultation list of previous year FYSO (2023-2028), it has been removed from the current year work plan. A discussion between interested stakeholders will facilitate the co-existence of two systems based on their technical characteristics more specifically considering the migration of LTE systems to 5G.

Radiocommunications Assignment and Licensing Instruction (RALI) MS 35 assists in the coordination and registration of 2.5 GHz band spectrum licensed transmitters (2500-2570 MHz and 2620-2690 MHz) with existing radiodetermination stations operated by the Department of Defence in the 2700-2900 MHz band. Given that the Bureau operates the largest number of S-band radars in Australia, based on RRL, and hence providing a visibility of such network in a new RALI or existing RALI MS35, will facilitate coordination between spectrum licensed transmitters and radiodetermination stations operated by the Bureau.

2.2. Protection of radioastronomy facility at Learmonth Solar Observatory

Learmonth Solar Observatory (LSO) is located at 22°13'09.4"S 114°06'11.0"E in Western Australia and is jointly operated by the Bureau and the United States Air Force since 1979. The LSO mission is to detect, measure, analyse and provide rapid reporting of all radio-frequency emissions above the sun's background level in support of Australian and US national security, Defence, aviation and other affected government agencies and asset owners.

The LSO collects radiofrequency observations of the sun using highly sensitive parabolic-antenna radio telescopes designed to monitor solar emissions across eight discreet frequencies between 245 - 15400MHz. Given that humans become increasingly reliant on space-based technologies, it is critical that both Australian and US agencies and stakeholders continue to receive timely and accurate space weather observations and warnings to enable mitigation of damage to susceptible assets. The ongoing successful operation of the Learmonth Solar Observatory is highly reliant on access to a well-protected radiofrequency spectrum.

There are an increasing number of potential industrial developments in the area around LSO and as such, it is important to modify and amend the regulatory status of the spectrum for protection of LSO frequency bands for ongoing successful operation of Learmonth Solar Observatory. To ensure smooth operation and future extension of the observatory, the Bureau suggests a range of changes, or part thereof, as below:

- Modification of ARSP for inclusion of Learmonth Solar Observatory. Given the requirement for modification of “Australian Radiofrequency Spectrum Plan” (ARSP) after WRC23, it is suggested to amend AUS 87 for inclusion of LSO and their specific frequency bands in the footnote AUS 87, and modifying Chapter 1, Part 4, Section 14 of the ARSP for referring to the LSO as another observatory station in Australia. This provides greater visibility to other spectrum users.
- Modification of RALI MS 31 for inclusion of LSO and all or part of its frequency bands. This will ensure the Bureau is notified in a timely manner of new transmitters in the area, to mitigate the impact of potential interference that might undermine data quality.
- Modification of RALI FX 3 for implementation of coordination requirements for new fixed point to point links to ensure protection of the LSO in 15 GHz band.

The Bureau notes that ACMA's spectrum planning options framework considers environmental factors, including technical issues. As we approach the solar cycle peak in 2025, the expected frequency and severity of space weather events is likely to increase. Statistically, high impact events are also more likely in the year or two following the peak of the cycle (2025-2028). The Sun can emit radio signals that can interfere across a wide range of frequencies, primarily from HF (3-30 MHz) through to L-band (1-2GHz) for some extreme events. Interference is more likely below 180 MHz. Consequently, the Learmonth Solar Observatory monitors this part of the spectrum closely for solar activity.

The Bureau recommends that the increased likelihood of space weather interference across lower frequency bands being used by Emergency Management, aviation, and Defence be noted for awareness and planning purposes. In addition, the operators of ground segment of space-based (satellite) systems could be impacted by significant space weather events.

2.3. Satellite earth observations

The Bureau uses satellites to access critical environmental data on drought, floods, fires, and thunderstorms, for direct use in products and warnings. It also incorporates massive amounts of satellite data into its weather, ocean, water and air quality forecasts. This results in significant improvements in forecast accuracy and directly translates into economic benefit through improved decision making and support for the activities of Australian industry and other stakeholders.

There are constraints on the spectrum appropriate for satellite earth observations data based on physics and the (requirements of) foreign satellite operators. A lack of access to dedicated spectrum for these applications will interfere with the maintenance and development of space capability to meet obligations of the Meteorology Act and to meet our customers' needs. The choice of radiofrequency spectrum for these applications is determined by environmental physics and foreign satellite operators.

Various entities in earth observation compete for allocation of spectrum due to their commercial interests, in addition, in metropolitan areas, commercial services (including fixed and mobile telephony) are often given preference, which forces the relocation of earth stations to locations that are a large distance from hubs and centres. This adds to costs and has associated security risks.

Considering the benefits to the Australian community the Bureau recommends that meteorological-satellite bands are retained and protected from future interference from commercial users sharing the same or adjacent bands.

2.3.1. Protection of passive and active bands used for earth observations

The Bureau uses data from around 30 earth observations satellites in its operational weather, ocean and land/hydrology models, and in the forecasts and warnings delivered to the Australian community.

Earth observation data is essential for monitoring and predicting climate change, for disaster prediction, monitoring and mitigation, for increasing the understanding, modelling and verification of all aspects of climate change, and for related policy making.

Earth observation satellites use passive and active technologies to observe the atmosphere and Earth. **Passive** sensing is the measurement of naturally occurring radiation, usually of very low power levels, which provides essential information on physical processes.

The relevant frequency bands are determined by *fixed* physical properties (molecular resonance) that cannot be changed or ignored, nor can these physical properties to be duplicated in other bands. Therefore, these frequency bands are an important natural resource. Even low-level interference can be problematic as it is difficult to detect and remove. In most cases passive sensors cannot discriminate between natural and man-made radiation.

Where passive sensing bands are shared with **active** services, the situation is becoming critical because the increased density of terrestrial active devices are causing serious cases of interference.

The Bureau recommends a new subheading and section under **'The policy environment and regulatory reform** section:

Passive and active bands for satellite Earth observation

Over 95% of the observations used by the Bureau of Meteorology in its weather forecast models are from satellites. Satellite observations also support our understanding of climate processes, and are used for monitoring drought and land degradation, sea surface temperatures, and the quality of inland water bodies.

Many meteorological satellites use passive sensing techniques that measure the very low-power microwave radiances naturally emitted from the atmosphere and the Earth's surface. These passive techniques are the most vulnerable to interference from new technologies.

Meteorological satellites use different frequencies across a wide range of frequency bands. As an example, a frequency around 1.4 GHz is best for ocean salinity and measurements, around 6 GHz offers the best sensitivity to sea surface temperature. Similarly, measurement in 17–19 GHz region offers optimal performance for ocean-surface emissivity, while atmospheric total water content is best measured around 24 GHz, with liquid clouds best measured at 36 GHz.

The Bureau has already seen evidence of radio frequency interference in the L (~1.4 GHz), C (~6.9 GHz), X (~10.7 GHz) and K (~18.7 GHz) frequency bands, notably on the European SMOS instrument and the Japanese AMSR2 instrument. Loss of these and other bands due to radiofrequency interference would have a catastrophic effect on the quality of the Bureau's forecasts and warnings.

New applications (e.g. 5/6G) outside the field of meteorology are interested in higher frequencies, such as in bands adjacent to 24 GHz and 50 GHz, which are crucial for obtaining accurate estimates of water vapour and temperature. We need to ensure protection is in place to limit the level of out-of-band emissions from active systems operating in neighbouring bands (e.g. emissions from the 5G band between 24.25 GHz and 27.5 GHz affecting the passive band 23.6–24.0 GHz).

Without satellite Earth observations, the Bureau cannot predict weather, climate and water-related hazards and protect the lives and property of all Australians with the degree of accuracy that we have come to expect. Lower accuracy forecasts result in less timely warnings of severe weather, and potential significant economic costs and harm to people and property.

The Bureau seeks protection of frequencies that are vital to weather forecasts and warnings. More specifically, protection from out-of-band and spurious radiofrequency emissions of active services that could affect frequencies near 7 to 8 GHz band, as well as bands above 76 GHz are important.

The Bureau also believes that new primary allocations to the EESS (passive) in the 4.2-4.4 GHz and 8.4-8.5 GHz bands for SST measurements should be supported.