**Proposed licensing arrangements for 2 GHz narrowband mobile-satellite services and 28 GHz fixed-satellite services**

Consultation paper

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Executive summary

The Australian Communications and Media Authority (ACMA) is considering arrangements to authorise the use of uncoordinated earth station receivers under class-licensing arrangements in 2 frequency bands:

* part of the 2 GHz band in the frequency range 2005–2010 MHz paired with the frequency range 2195–2200 MHz, a bandwidth of 2 x 5 MHz (the 2 GHz narrowband mobile-satellite service segment)
* the 28 GHz band in the frequency range 27.5–28.3 GHz.

To implement these arrangements, we propose to vary the[Radiocommunications (Communication with Space Object) Class Licence 2015](https://www.legislation.gov.au/Details/F2021C00630) (CSO class licence), as detailed in the accompanying draft Radiocommunications (Communication With Space Object) Class Licence Variation 2022 (No.1)(the draft variation).

## 2 GHz narrowband mobile-satellite services

In the 2 GHz band, these arrangements were foreshadowed in the 2 GHz [outcomes paper](https://www.acma.gov.au/consultations/2020-07/replanning-options-2-ghz-band-consultation-232020) published in January 2021, in which we detailed our decisions to replan the 2 GHz band (1980–2010 MHz paired with 2170–2200 MHz) for mobile-satellite services (MSS).

The proposals presented in this paper would enable use of the upper 2 x 5 MHz of the 2 GHz band for innovative narrowband mobile-satellite applications such as telemetry, short messaging, and low-data-rate services such as satellite internet of things (IoT) applications. These arrangements are intended to provide spectrum access to new entrants with minimal regulatory arrangements, thereby supporting growth in the Australian space industry, while maintaining coexistence with adjacent-band television outside broadcast (TOB) services. The technical requirements were developed with regard to the 3GPP work on 2 GHz Non-Terrestrial Networks (TR 36.763).[[1]](#footnote-1)

The proposed arrangements will support satellite systems with numerous or ubiquitous earth stations without the need for individual coordination. We will also continue to support operation of scientific licences in the 2 GHz band for experimental and demonstration purposes for satellite and other uses consistent with the 2 GHz outcomes on a short-term basis. Appropriate interference management arrangements will protect TOB services during transition of the 2 GHz band from TOB to MSS use.[[2]](#footnote-2)

The frequency ranges for narrowband MSS and technical requirements to achieve coexistence with adjacent-band services are included in the draft variation.

The draft variation is intended to enable operators of space-based communication systems to deploy ubiquitous earth stations in the 2 GHz narrowband MSS segment, without having to individually licence and coordinate each station. This is particularly beneficial to operators of satellite IoT or other remote-sensing systems, where a large number of direct-to-satellite ground devices (earth stations) may be deployed by end users.

The technical conditions proposed at subsections 8(4) and 8(5) of the draft variation require that an earth station transmitter operating in the narrowband MSS segment:

* must not be airborne, as this would pose an unacceptable interference risk to adjacent-band services
* must not produce emissions above the frequency 2010 MHz exceeding a maximum equivalent isotropic radiated power (EIRP) of 66 dBW/MHz (again, to minimise interference risk to adjacent-band services)
* when operating in metropolitan areas:
* EIRP is restricted to a maximum of 0.5 dBW/MHz
* the maximum duty cycle must not exceed 1% averaged over 15 minutes, with a maximum burst duration of 4 seconds.

These conditions are designed to enable the band to be shared by multiple satellite operators while achieving coexistence with other radiocommunications services, particularly TOB services in the upper-adjacent band. Key parameters in this sharing arrangement are the use of low powers and low duty cycles.

For areas outside a metropolitan area where use of TOB services is limited, it may be possible to support a less restrictive duty cycle and higher radiated power levels (up to the higher levels supported by 3GPP, that is 17.3 dBW/MHz), with appropriate measures to achieve co-existence with adjacent-band TOB services. For this reason, the proposed variation to the CSO class licence does not include limits on duty cycle and radiated power levels outside metropolitan areas.

Industry views are sought on whether limits should be specified in the CSO class licence, as well as appropriate measures to assess licence applications and appropriate limits on radiated power and duty cycle.

If the draft variation is made, consequential updates will be required to our business procedures for assessing satellite regulatory aspects of apparatus licence applications for [space and space receive](https://www.acma.gov.au/publications/2020-08/guide/submission-and-processing-applications-space-and-space-receive-apparatus-licences) licences to include:

* advice on the conditions of the CSO class licence and a requirement to supply evidence that operation of an earth station will be in accordance with those conditions
* advice on how narrowband MSS operates on a shared basis
* requirements to protect TOB services, both during transition of the 2 GHz band from TOB to MSS use, and long-term for adjacent-band TOB services.

The 2 GHz narrowband MSS segment is intended to become available for use under a phased implementation approach once the draft variation is made. Initially, it is intended that operation will only be permitted outside of metropolitan areas and designated areas.[[3]](#footnote-3) A 2 GHz narrowband MSS service may not commence in metropolitan and designated areas before 1 March 2026. Before operating a service, the operating entity must first be listed in either the [Radiocommunications (Australian Space Objects) Determination 2014](https://www.legislation.gov.au/Details/F2021C00361) or the [Radiocommunications (Foreign Space Objects) Determination 2014](https://www.legislation.gov.au/Details/F2021C00363/)*,* and then obtain space and space receive licences to authorise operation of the space-based segment of the satellite system.

**28 GHz fixed-satellite services**

In 2019, we concluded our review of the 28 GHz band (27.5–29.5 GHz) with the release of the paper [*Future use of the 28 GHz band—Planning decisions and preliminary views*](https://acma.gov.au/sites/default/files/2019-11/Future-use-of-the-28-GHz-band-Final.docx) (28 GHz outcomes paper). A key outcome of this review was to expand arrangements for ubiquitous uncoordinated fixed-satellite service (FSS) earth station deployments (referred to as ubiquitous FSS)[[4]](#footnote-4) in the 28 GHz band.

In February 2020, we made amendments to the CSO class licence to expand arrangements for ubiquitous FSS earth stations across the frequency range 28.3–30 GHz, from the previous sub-segments of this band. The frequency range 27.5–28.3 GHz was not included in the updates to the CSO class licence at that time, due to a need for further investigation into possible coexistence between ubiquitous FSS and primary fixed wireless access (FWA) services operating in defined population centres[[5]](#footnote-5) below 28.1 GHz, as indicated in the 28 GHz outcomes paper.

Following informal industry engagement in early 2021, we completed technical analysis in July 2021 and published the technical paper, [*Uncoordinated ubiquitous FSS earth station coexistence with FWA in the 28 GHz band*](https://www.acma.gov.au/consultations/2021-12/proposed-licensing-arrangements-2-ghz-narrowband-mobile-satellite-services-and-28-ghz-fixed-satellite-services-consultation-462021)*,* in support of the proposed CSO class licence amendments in this paper.

The technical conditions proposed at subsections 8(6) to 8(8) of the draft variation would require that an earth station transmitter operating in the 27.5–28.3 GHz frequency range adhere to the following technical conditions:

* on an aircraft, in the air, an aeronautical earth station (A-ESIM), irrespective of altitude, is required to not exceed the power flux density limits as specified in clause 3.1 of Part II of Annex 3 to the *ITU-R Resolution 169 (WRC-19)* for any emissions that fall in the frequency range 27.5–28.1 GHz in a defined population centre
* on a ship, a maritime earth station (M-ESIM) is required to not exceed the power flux density limit on the shore of -112.2 dBW per m2 for each MHz at a height of 30 metres above ground on the shoreline, for any emissions that fall in the frequency range 27.5–28.1 GHz in a defined population centre
* land-based earth stations (L-ESIM and VSAT) are excluded from operation inside defined population centres in the frequency range 27.5–28.1 GHz
* land-based earth stations cannot exceed a maximum EIRP to the horizon of ‑17.8 dBW in a 1 MHz bandwidth, within 30 kilometres of a defined population centre
* land-based earth stations at the lower frequency boundary (28.1 GHz for inside a defined population centre and 27.5 GHz for outside a defined population centre) must operate at the greater frequency separation determined by either operating beyond twice the occupied bandwidth (that is, the second adjacent channel) of the ubiquitous FSS (limited to a maximum of 200 MHz) or operating 50 MHz from the relevant lower frequency boundary.

# Issues for comment

This consultation does not ask specific questions. We welcome feedback from interested stakeholders on the issues raised in this consultation paper and the accompanying draft variation to the CSO class licence.

# Introduction

## Background

### 2 GHz narrowband MSS segment

In January 2021, the Australian Communications and Media Authority (ACMA) published the [outcomes](https://www.acma.gov.au/consultations/2020-07/replanning-options-2-ghz-band-consultation-232020) of the 2 GHz band review, which detailed our decision to replan the band for mobile-satellite services (MSS), including:

* Australia-wide MSS in the frequency range 1980–2005 MHz paired with 2170–2195 MHz (a bandwidth of 2 x 25 MHz) for exclusive apparatus-licensed use. Supporting apparatus-licensing arrangements will also be developed to facilitate deployment of a complementary ground component (including direct air-to-ground communications service) where a mobile-satellite licensee(s) wishes to supplement its mobile-satellite service.
* Australia-wide narrowband MSS in the frequency range 2005–2010 MHz and 2195–2200 MHz (a bandwidth of 2 x 5 MHz) for shared use by services such as telemetry, short messaging, and low-date-rate services (for example, satellite internet of things (IoT) applications).

The 2 GHz band is currently used for television outside broadcast (TOB) services on a shared and non-exclusive basis for short-term applications, such as covering special events. To support the introduction of MSS in the band, TOB services will be required to stop operating in the band over a proposed transition period ending 28 February 2026 in metropolitan areas (capital cities and surrounds), and a shorter transition period ending 29 February 2024 in regional and remote areas where TOB usage is minimal.

Technical restrictions on MSS are required in the 2 GHz narrowband MSS segment to protect adjacent-band TOB services (in the 2010–2110 MHz and 2200–2300 MHz frequency ranges) from MSS. In part, this protection is provided by not supporting complementary ground component services in the narrowband MSS segment. The 2 GHz outcomes paper also suggested that arrangements supporting narrowband MSS in the 2005–2010 MHz and 2195–2200 MHz frequency ranges could be developed that also provide protection to adjacent-band TOB services. Proposed arrangements for such operations are presented in this paper.

To assist in developing arrangements presented in this paper, we convened an informal industry discussion group from August to October 2021 comprising stakeholders with a potential interest in using the 2 GHz narrowband MSS segment. The group comprised satellite operators, adjacent-band licensees and other interested industry stakeholders.

The proposals presented in this paper are part of a broader program of work to implement outcomes of the 2 GHz band review. To date, we have amended 2 planning instruments, [Embargo 23](https://www.acma.gov.au/publications/2019-10/rules/embargo-23) and [RALI FX21](https://www.acma.gov.au/publications/2019-09/instruction/rali-fx21-television-outside-broadcasting-services), to limit any new or reissued TOB licences to a period of no longer than one year, and to note on these licences that forthcoming replanning activities in the 2 GHz band may require licensees to change frequency or cease transmission.

We are also conducting a concurrent consultation on proposed transition arrangements for TOB services in the 2 GHz band. To implement these arrangements, we propose to make 2 new frequency band plans, respectively, for MSS and TOB services (the 2 GHz band plans). For further information, please refer to our consultation paper, [*Replanning the 2 GHz band: Review of the 2 GHz Television Outside Broadcast Frequency Band Plan*](https://www.acma.gov.au/consultations/2021-12/replanning-2-ghz-band-review-2-ghz-television-outside-broadcast-frequency-band-plan-consultation-452021).

### 28 GHz fixed-satellite services

In September 2019, we concluded our review of the frequency range
27.5–29.5 GHz (28 GHz band) with the release of the paper, [*Future use of the
28 GHz band—Planning decisions and preliminary views*](https://acma.gov.au/sites/default/files/2019-11/Future-use-of-the-28-GHz-band-Final.docx) (the outcomes paper). A key outcome of this review was to expand arrangements for ubiquitous uncoordinated fixed-satellite service (FSS) earth station deployments (referred to as ‘ubiquitous FSS’) in the 28 GHz band. The frequency arrangements are illustrated in Figure 1.

1. Planned arrangements for the 28 GHz band

|  |  |
| --- | --- |
| 27.5–28.1 (600 MHz)INSIDE POP. CENTRESPrimary: FWA/FSS gatewaySecondary: Ubiquitous FSS\* | 28.1–29.5 GHz (1400 MHz)AUSTRALIA-WIDEPrimary: All FSSSecondary: FWA |
| 27.5–28.1 GHz (600 MHz)OUTSIDE POP. CENTRESPrimary: All FSSSecondary: FWA |

\* The possibility of FSS deployments, including any restrictions on use, as foreshadowed in the outcomes paper, have been further investigated and are detailed in this paper.

In [February 2020](https://www.legislation.gov.au/Details/F2020L00181), the ACMA made amendments to the CSO class licence to include the frequency ranges 28.3–28.5 GHz and 29.1–29.5 GHz, expanding the allocation for ubiquitous FSS earth stations to cover the whole of the 28.3–30 GHz band. The frequency range 27.5–28.3 GHz was not included in the updates to the CSO class licence at that time, due to a need for further investigation into possible coexistence between ubiquitous FSS and primary fixed wireless access (FWA) services operating in defined population centres[[6]](#footnote-6) below 28.1 GHz.

We completed our technical analysis and developed a technical paper, [*Uncoordinated ubiquitous FSS earth station coexistence with FWA in the 28 GHz band*](https://www.acma.gov.au/consultations/2021-12/proposed-licensing-arrangements-2-ghz-narrowband-mobile-satellite-services-and-28-ghz-fixed-satellite-services-consultation-462021). This paper presented our views related to proposed changes to the CSO class licence to provide support for ubiquitous FSS use of the 27.5–28.3 GHz frequency range. The technical paper also reviewed the existing co-existence arrangements between ubiquitous FSS and incumbent point-to-point (PTP) services operating in the 28.1–29.5 GHz frequency range.

Given the complexity of the issues involved, we provided a preliminary draft of the technical paper to stakeholders in January 2021 to receive feedback on the studies and preliminary views. The feedback received was used to inform the final analyses in the technical paper. The outcomes from the technical paper are used in support of the proposed CSO class licence amendments in this paper.

## Licensing of space-based communication systems

As for all other types of radiocommunications, a space-based radiocommunications system may not be operated in Australia without a licence. In general, there are 2 broad options for licensing space systems in Australia.

The first option requires operators to obtain apparatus licences for each of their earth stations individually: an *earth licence* for the uplink and an *earth receive licence* for the downlink. Under this approach, a licence is not required for the space stations or space receive stations onboard a satellite.

The second option involves a combination of apparatus and class licences. In certain bands specified in the CSO class licence, it requires operators to obtain an apparatus licence for the space stations onboard a satellite with a *space licence* for the downlink and a *space receive licence* for the uplink. Earth stations in the system are then automatically authorised collectively under the CSO class licence. This approach is typically used for satellite systems with numerous or ubiquitous FSS earth stations. It provides an efficient means of licensing a large number of earth stations and avoids the need to obtain a licence for every earth station in a satellite system.

A key requirement, irrespective of which approach to licensing is used, is that the satellite system must be filed with the International Telecommunication Union (ITU) by the ACMA or the equivalent national administration of another ITU member state.

If an operator wishes to licence a satellite system under the second option, the controlling business entity must first be included in either the [Radiocommunications (Australian Space Objects) Determination 2014](https://www.legislation.gov.au/Details/F2021C00361) or the [Radiocommunications (Foreign Space Objects) Determination 2014](https://www.legislation.gov.au/Details/F2021C00363/).

Information on how licence applications for space-based radiocommunications systems are assessed for compliance with ITU and other satellite regulatory matters is outlined in the ACMA’s [business operating procedures](https://www.acma.gov.au/business-operating-procedures-spectrum).[[7]](#footnote-7)

### CSO class licence

The [Radiocommunications (Communication with Space Object) Class Licence 2015](https://www.legislation.gov.au/Details/F2021C00630) is a legislative instrument made by the ACMA under section 132 of the *Radiocommunications Act 1992*. It provides a standing authorisation for the operation of earth stations in specified frequency bands if the operator of an associated satellite system has obtained space and space receive licences authorising operation of the space-based segment of their system.

The CSO class licence also sets out equipment rules that earth stations authorised by this licence must comply with, as well as technical conditions that must be met for transmissions in certain bands to minimise interference with other radiocommunications services.

### International obligations

The ACMA’s current practice is that a satellite filing with the ITU for the associated space object will be required, in accordance with Australia’s obligations as a member of the ITU.

It should be noted that while the ACMA can develop a framework to support the licensing of a satellite service, the viability of a satellite service is in large part dependent on the status of the satellite system in the ITU satellite coordination process. This is a matter for prospective licensees to assess, and the ACMA can make no assurances in this regard.

# 2 GHz narrowband mobile-satellite services

Our objective in developing licensing and technical arrangements for the 2 GHz narrowband MSS segment is to provide a low barrier to entry to support innovative satellite applications, offer opportunities for new entrants and support growth in the Australian space industry.

The technical parameters specified below are intended to maximise use of the 2 GHz narrowband MSS segment while achieving coexistence with adjacent-band services. Restricted spectrum arrangements are required in these segments to provide protection for TOB services in the upper-adjacent band, ensuring that the spectrum environment is similar to that currently supported.

To inform development of parameters for the 2 GHz narrowband MSS segment, the ACMA formed a mobile-satellite services narrowband (MSSNB) industry group. The group was informal and made no planning decisions. Its purpose was to provide advice on possible options to inform our development of technical and licensing arrangements for narrowband MSS. The group comprised satellite operators, adjacent-band licensees and other interested industry stakeholders.

To identify appropriate parameters, we prepared a literature review of terrestrial and satellite-based IoT systems, as well as MSS systems (below 3 GHz) in general (see [Appendix A](file:///J%3A%5CPublications%5CDiscussion%20papers%20and%20reports%5CConsultation%20papers%5C2021%5CCSO%20class%20licence_Stuart%20Malloch%5Cfinals%5CProposed%20licensing%20for%202%20GHz%20narrowband%20MSS%20and%2028%20GHz%20FSS_Consultation.docx#_Appendix_A:_2)). Following presentation of the results of the literature review to the MSSNB industry group, the feedback was that 2 GHz MSS systems being developed are likely to meet the technical requirements of 3GPP work on 2 GHz Non-Terrestrial Networks (TR 36.763).[[8]](#footnote-8) Technical parameters based on the 3GPP work were developed for discussion within the group.

While consensus was not reached within the group, the information gathered has informed our development of technical and licensing arrangements for narrowband MSS proposed in this paper.

Gateway earth stations are a component of MSS systems. We are not considering arrangement for gateways in this band at this stage. Depending on interest from industry, we may consider developing arrangements for such systems in regional/remote areas in future (that is, in areas where adjacent-band coexistence considerations are less challenging than in metropolitan areas).

In summary, we propose to support narrowband MSS in the bands 2005–2010 MHz and 2195–2200 MHz with:

* the 2195–2200 MHz frequency range supporting earth station receivers
* the 2005–2010 MHz frequency range supporting earth station transmitters
* no restrictions proposed on earth station receivers
* emissions from earth station transmitters above 2010 MHz required not to exceed an EIRP of -66 dBW/MHz to protect adjacent-band services
* earth station transmitters not being permitted to operate when in the air, consistent with current arrangements for transmitters in the band and to protect adjacent-band services
* for earth stations transmitters when operating in metropolitan areas:
* EIRP being restricted to a maximum of 0.5 dBW/MHz
* duty cycle limits of 1% averaged over a 15-minute period being applied, with a maximum burst duration of 4 seconds.

For areas outside of metropolitan areas where TOB usage is limited, it may be possible to support a less restrictive duty cycle and higher power levels (for example, up to higher levels supported by 3GPP, that is up to 17.3 dBW/MHz), with appropriate measures to achieve co-existence with adjacent-band TOB services. For this reason, higher power limits are not proposed in the CSO class licence at this time. If support for higher powers in some areas were further investigated, some form of additional assessment as part of the licence application for the associated space licence/space receive licence process would be prudent. We welcome comments on appropriate measures to assess licence applications and appropriate limits on radiated power and duty cycle.

To implement these arrangements, we propose to vary the CSO class licence to include the frequency ranges for narrowband MSS and proposed technical restrictions, as specified in the draft variation.

If the draft variation and 2 GHz band plans are made, we will make consequential updates to ACMA policies on licensing and coordination arrangement for services in the 2 GHz band as recorded in [Embargo 23](https://www.acma.gov.au/publications/2019-10/rules/embargo-23), [RALI FX21](https://www.acma.gov.au/publications/2019-09/instruction/rali-fx21-television-outside-broadcasting-services) and ACMA [procedures](https://www.acma.gov.au/publications/2020-08/guide/submission-and-processing-applications-space-and-space-receive-apparatus-licences) for submission and processing of applications for space and space receive apparatus licences.

The rationale for the frequencies and technical conditions that we propose to add to the CSO class licence for 2 GHz narrowband MSS is detailed below.

## Authorised frequencies

The draft variation includes the frequencies 2005–2010 MHz for transmission and 2195–2200 MHz for reception in the list of authorised frequencies at section 6 of the CSO class licence. The effect of this amendment would be to add these frequencies to this class licence, thereby authorising their shared use under specified technical conditions by earth stations in a satellite system, subject to operators obtaining space and space receive licences authorising operation of the space-based segment of their system.

## Technical conditions

Parameters for narrowband MSS have been developed with regard to requirements for TOB services as contained in [RALI FX 21](https://www.acma.gov.au/publications/2019-09/instruction/rali-fx21-television-outside-broadcasting-services). Relevant requirements include:

* TOB services in the 1980–2010 and 2170–2200 MHz bands:
* the intended use is hand-held wireless video cameras
* maximum transmitter EIRP is limited to 23 dBm/8 MHz (-16 dBW/MHz)
* airborne TOB transmitters (for example, helicopters) are not permitted
* within the band 2175–2200 MHz, TOB transmitters are not to be operated within 100 kilometres of an earth station receiver operating within the band 2200–2300 MHz
* TOB services in the 2010–2110 and 2200–2300 MHz bands:
* a variety of platforms supported, such as wireless cameras, helicopters and ‘collection station receivers’ (central/high site receiving location with high antenna gain with omnidirectional coverage)
* collection station adjacent-channel protection requirement of -30 dB (wanted to unwanted), for other TOB services. While such a requirement is unlikely to be directly applicable when considering narrowband MSS, it can provide a guide[[9]](#footnote-9)
* no maximum transmitter EIRP
* spectrum mask: ETSI EN 300 744 (effectively -50 dB out of band for in-band power levels)
* interference threshold -147.3 dBW/MHz (based on Recommendation [ITU-R F.1777-2](https://www.itu.int/rec/R-REC-F.1777/en)).

### Power considerations

The current RALI FX 21 EIRP limit for TOB services in the 2 GHz band is 23 dBm/8 MHz (-16 dBW/MHz). In comparison, the literature review identified earth station transmitter power values that were higher, ranging from -1.6 dBW/MHz to 34 dBW/MHz, with channel bandwidth varying from 3.75 kHz to 1.23 MHz (that is, up to a 50 dB power difference compared to the current spectrum environment). As we have decided to develop parameters based on 3GPP, this restricts the power range under consideration from 0.5 dBW/MHz up to 17.3 dBW/MHz.

With TOB extensively used in metropolitan areas, we propose to place restrictions on earth station radiated power and transmit duty cycle to provide protection to adjacent-band TOB services.

The proposed EIRP limit of 0.5 dBW/MHz in metropolitan areas is informed by 3GPP S-band NB-IoT handset parameters of 23 dBm in a 180 kHz bandwidth. This a higher than the current RALI FX 21 EIRP power density limit for TOB services (by 16.5 dB). Mitigating the higher power level is the proposal that emissions from earth station transmitters above 2010 MHz are not to exceed an EIRP of ‑66 dBW/MHz. This requirement will limit the level of out-of-band emissions from an individual earth station to a level equivalent to that of a wireless camera. The duty cycle restrictions for earth stations will also support coexistence with TOB services.

Considering that narrowband MSS earth transmitters are not expected to employ any additional filtering, meeting the out-of-band emission level is likely to restrict the frequency range that narrowband earth transmitters can operate over at the full permitted power (for example, potentially reducing the availability by up to 1 MHz to 2005–2009 MHz), providing an additional mitigation for protection of adjacent-band services.

Another additional mitigator is that some narrowband MSS systems are likely to offload traffic onto terrestrial mobile broadband networks when in their coverage area.

In considering emissions from earth station transmitters in the adjacent band (that is, above 2010 MHz), our goal is to provide a similar spectrum environment to that existing for wireless cameras. To meet that objective, the limit for emissions from earth station transmitters above 2010 MHz is based on that expected of a typical wireless camera meeting the spectrum mask of ETSI EN 300 744. The result is that emissions from earth station transmitters above 2010 MHz are not to exceed an EIRP of ‑66 dBW/MHz.[[10]](#footnote-10)

### Restriction on airborne transmitters

To ensure compatibility of narrowband MSS with adjacent-band services, airborne earth station transmitter use would not be allowed (considering that current arrangements are designed to support handheld wireless cameras).

### Duty cycle

The envisaged narrowband MSS applications (telemetry, short messaging, and low-data-rate services such as satellite IoT) by their nature have an earth station transmit duty cycle facilitating sharing amongst multiple satellite systems. Data is usually asymmetric with more uplink transmission than downlink reception.

The proposed duty cycle limits for earth station transmitters in the band of 1% averaged over a 15-minute period, with a maximum burst duration of 4 seconds is intended to accommodate all systems identified in the literature review.

Downlink duty cycle requirements are not considered necessary at this stage, given the quantity of spectrum available and the asymmetry between uplink transmission times and downlink reception times.

## Interference management

As a general principle, stations operating under the CSO class licence do so on the basis that operation of the station does not interfere with the operation of a radiocommunications receiver, and stations are not afforded protection from interference caused by a radiocommunications transmitter of other radiocommunications services. We discuss below the application of this to narrowband MSS.

### Sharing between narrowband MSS

The 2 GHz narrowband MSS segment is intended to be used on a shared basis where no satellite operator has exclusive use. Satellite operators are expected to coordinate use with each other, without involvement from the ACMA. Information on this requirement will be included in the ACMA licensing procedures for space and space receive apparatus licences.

We are open to considering additional guidance in the licensing procedures for space and space receive apparatus licences on mechanisms to support sharing, such as number of devices and/or antenna polarisation, if a case is made by industry with accompanying proposals.

We do not intend to limit the number of operators[[11]](#footnote-11), but welcome views as to whether guidance should be provided on this matter.

### Mid-west radio quiet zone

The [Radiocommunications (Mid-West Radio Quiet Zone) Frequency Band Plan 2011](https://www.legislation.gov.au/Details/F2011L01520) establishes a radio quiet zone (RQZ) in the mid-west region of Western Australia, and facilitates the development and use of new radioastronomy technologies at that site by maintaining its ‘radio-quietness’.

Existing requirements for protection of the mid-west RQZ that apply to stations operating under the CSO class licence will apply to narrowband MSS. These requirements restrict operation within 70 kilometres of the mid-west RQZ. MSS operators intending to operate in the mid-west RQZ are advised to contact the CSIRO as the responsible entity for operating the Murchison Radioastronomy Observatory.

### Protection of TOB services during the transition period

During the TOB transition period, the operation of MSS will be restricted to protect TOB services in the transition to new arrangements. Note these arrangements will commence once the CSO class licence is varied, the 2 GHz band plans are made and any consequential updates to ACMA licensing and planning documentation have been completed.

MSS and TOB transitional arrangements in the 2 GHz band\*

|  |  |  |
| --- | --- | --- |
| Area | Service | Requirement  |
| Metropolitan areas and designated areas[[12]](#footnote-12)  | TOB | Operations cease by 28 February 2026,protected from narrowband MSS until then. |
| Narrowband MSS | Operations not to commence until 1 March 2026. |
| MSS (2 x 25 MHz) | Licence allocation arrangements to be determined. Operations not to commence until 1 March 2026. |
| Outside metropolitan areas and outside designated areas | TOB | Operations cease by 29 February 2024, protected from narrowband MSS until then. |
| Narrowband MSS | Until 29 February 2024, operation is on the basis of no protection afforded from TOB and no interference to TOB.From 1 March 2024 until 28 February 2026, only TOB services in metropolitan areas and designated areas require protection. |
| MSS (2 x 25 MHz) | Licence allocation arrangements to be determined.Until 29 February 2024, operation is on the basis of no protection afforded from TOB and no interference to TOB.From 1 March 2024 until 28 February 2026, only TOB services in metropolitan areas and designated areas require protection. |

\* Coexistence arrangements between 2 GHz MSS and TOB in the adjacent band (2010–2110 MHz/2200–2300 MHz) will be developed and this will include MSS operations being afforded no protection from adjacent-band TOB services.

Protection of TOB services in the 2 GHz band during the transition will require narrowband MSS services to restrict operations in the vicinity of metropolitan and designated areas. Protection requirements for TOB services (-147 dBW/MHz) could require separation distances up to 30–40 kilometres, depending on narrowband MSS earth station parameters and TOB receiver antenna height and gain.

For protection of TOB services in areas outside metropolitan areas, separation distances should be determined using the parameters of licensed TOB services.

For protection of services in metropolitan areas, given the likely higher usage of TOB services, the area is to be protected on the basis that TOB service can operate anywhere in the area.

The proposed parameters for narrowband MSS systems are intended to protect adjacent-band TOB services. If (as noted above) in areas outside of metropolitan areas different parameters for narrowband MSS system are supported from those proposed, additional requirements might be needed.

## ITU and licensing requirements for narrowband MSS

In line with Australia’s obligations as a member of the ITU, the ACMA will only authorise operation of a satellite service if there is a corresponding ITU satellite filing for the satellite system. It is the responsibility of the satellite operators intending to provide services to Australia to ensure that the ITU filing is consistent with intended operation in Australia.

While the ACMA can develop a domestic framework for narrowband MSS, as with any satellite service, its viability is in part dependent on the status of the satellite system in the ITU satellite coordination process, which is the responsibility of the satellite operator to manage. Satellite operators intending to provide narrowband MSS in Australia will need to consider the impact on satellite systems operating outside of Australia.

If interference were to occur between a narrowband MSS system operating in Australia and MSS systems operating outside of Australia, the ACMA would consider that it is the responsibility of the satellite operators and relevant national administration managing the ITU filing to resolve the interference in accordance with ITU procedures. The ACMA would normally only be involved if one of the satellite operators is operating under an Australian-filed satellite system with the ITU.

## Next steps

Subject to feedback received, we anticipate making the proposed amendments to the CSO class licence by the end of Q1 2022.

If the amendments are made, consequential updates will also be made to the ACMA business operating procedures for assessing satellite regulatory aspects of apparatus licence applications for [space and space receive](https://www.acma.gov.au/publications/2020-08/guide/submission-and-processing-applications-space-and-space-receive-apparatus-licences) licences to include a requirement to supply evidence that operation will be in accordance with the new arrangements.

Spectrum availability for 2 GHz narrowband MSS services in the timeframes specified in Table 1 will be subject to implementation of arrangements proposed in our concurrent consultation on proposed transition timelines for TOB services in the 2 GHz band.

# 28 GHz ubiquitous fixed-satellite services

As outlined in [the 28 GHz outcomes paper](https://acma.gov.au/sites/default/files/2019-11/Future-use-of-the-28-GHz-band-Final.docx), our objective is to develop licensing and technical arrangements for FWA and ubiquitous FSS in the 27.5–29.5 GHz frequency range.

The technical parameters specified below are intended to maximise use of the 28 GHz band while achieving coexistence between co-channel and adjacent-band services consistent with their status in the band. These technical parameters have been informed by the technical analysis conducted by the ACMA. We have therefore proposed some restrictions on arrangements in the 27.5–28.3 GHz frequency range to achieve co-existence with co-primary FWA services in a defined population area.

To implement these arrangements, we propose to vary the CSO class licence as detailed in the accompanying draft variation.

The frequencies and technical conditions that we propose to add to the CSO class licence are detailed below.

## Authorised frequencies

The draft variation would amend the current 28.3–30 GHz frequency range for earth station transmissions found in the list of authorised frequencies in section 6 of the CSO class licence to 27.5–30 GHz.

The effect of this amendment would be to allow some ubiquitous FSS transmitters to operate in the 27.5–28.3 GHz frequency range under the CSO class licence. The proposed amendment would authorise their shared use under specified technical conditions.

If the draft variation is made, consequential updates will be required to the ACMA business procedures for assessing satellite regulatory aspects of apparatus licence applications for [space and space receive](https://www.acma.gov.au/publications/2020-08/guide/submission-and-processing-applications-space-and-space-receive-apparatus-licences) licences to include:

* advice on the conditions of the CSO class licence and a requirement to supply evidence that operation of earth stations will be in accordance with the conditions of the class licence
* advice in determining potential interference from ubiquitous FSS to point-to-point services.

## Technical conditions

The proposed draft variation would require that an earth station transmitter operating in the 27.5–28.3 GHz frequency range adhere to the following technical conditions:

* an earth station on an aircraft (A-ESIM), in the air, irrespective of altitude, is required to not exceed the power flux density limits as specified in clause 3.1 of Part II of Annex 3 to the *ITU-R Resolution 169 (WRC-19)* for any emissions that fall in the frequency range 27.5–28.1 GHz in a defined population centre
* an earth station on a ship (M-ESIM), is required to not exceed the power flux density limit on the shore of -112.2 dBW per m2 for each MHz at a height of 30 metres on the shoreline, for any emissions that fall in the frequency range 27.5–28.1 GHz in a defined population centre
* an earth station that is operated on land (L-ESIM and VSAT):

> is excluded from operating in a defined population centre in the frequency range 27.5–28.1 GHz

> in a defined population centre in the frequency range 28.1–28.3 GHz is excluded from operating within the greater of 50 MHz or twice the occupied bandwidth of the station, from the frequency boundary of 28.1 GHz

> outside a defined population centre in the frequency range 27.5–27.7 GHz does not operate within the greater of either 50 MHz or twice the occupied bandwidth of the station, up to 200 MHz, from the frequency boundary of 27.5 GHz

> outside a defined population centre in the frequency range 27.5–28.1 GHz cannot exceed a maximum EIRP to the horizon of -17.8 dBW in a 1 MHz bandwith, within 30 kilometres of a defined population centre.

### Power limits

Considering the requirement to provide compatibility with adjacent-band services, we propose a power limit as follows for an earth station operating in the frequency range 27.5–28.1 GHz outside a defined population centre:

* a maximum EIRP to the horizon of 12.2 dBm in a 1 MHz bandwidth (-17.8 dBW/MHz) within 30 kilometres of a defined population centre.

## Next steps

Subject to feedback received, we anticipate making the proposed amendments to the CSO class licence by the end of Q1 of 2022.

If the amendments are made, consequential updates will also be made to the ACMA business operating procedures for assessing satellite regulatory aspects of apparatus licence applications for [space and space receive](https://www.acma.gov.au/publications/2020-08/guide/submission-and-processing-applications-space-and-space-receive-apparatus-licences) licences to include a requirement to supply evidence that operation will be in accordance with the new arrangements.

# Invitation to comment

## Making a submission

We invite comments on the issues set out in this consultation paper.

* [Online submissions](https://www.acma.gov.au/have-your-say) can be made by uploading a document. Submissions in PDF, Microsoft Word or Rich Text Format are preferred.
* Submissions by post can be sent to:

The Manager

Space Systems Section

Australian Communications and Media Authority

PO Box 78

Belconnen ACT 2616

The closing date for submissions is COB, **Monday** **28 February 2022**.

Consultation enquiries can be emailed to satellilte.coordination@acma.gov.au

#### Publication of submissions

We publish submissions on our website, including personal information (such as names and contact details), except for information that you have claimed (and we have accepted) is confidential.

Confidential information will not be published or otherwise released unless required or authorised by law.

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# Appendix A: 2 GHz narrowband MSS literature review

The ACMA literature review was focused on identifying information on terrestrial and satellite-based internet of things (IoT) systems, as well as MSS (<3 GHz) systems in general.

The review identified documents from the 3rd Generation Partnership Project (3GPP), the ACMA, the Electronic Communications Committee (ECC), the United States Federal Communications Commission (FCC) and the International Telecommunication Union (ITU) as potentially containing information relevant to the development of technical parameters for narrowband MSS systems.

The content of the documents identified is outlined below and summarised in *Table 4: Summary of narrowband MSS technical parameters for comparison*.

**ACMA**

ACMA consultation [IFC 28/2020 *New arrangements for low interference potential device*](https://www.acma.gov.au/consultations/2020-09/new-arrangements-low-interference-potential-devices-consultation-282020)*s* proposed implementing IoT in the 900 MHz band and in the VHF high band.

In the 928–935 MHz band, the consultation proposed the use of fixed telecommand or telemetry transmitters on a non-exclusive basis:

* EIRP not exceeding 25 mW (14 dBm)
* radiated PSD not exceeding -14.5 dBm/kHz
* maximum proposed duty cycle 0.1% averaged over one hour on any one frequency.

The IFC 28/2020 consultation referred to the ACMA discussion paper [*Internet of Things applications in the VHF high band*](https://www.acma.gov.au/consultations/2020-07/internet-things-applications-vhf-high-band-consultation-202020) (VHF IoT discussion paper), which proposed to establish arrangements similar to those in place in Europe for the 169.4–169.4875 MHz, 169.4875–169.5875 MHz and 169.5875–169.8125 MHz frequency segments, noting the proposed power and duty cycle constraints are below those of devices already operating harmoniously in the band.

The proposed technical conditions in IFC 28/2020 (see Table 1 of that publication) were identical to those included in the VHF IoT discussion paper and mirrored those in [ERC Recommendation 70-03](https://docdb.cept.org/download/25c41779-cd6e/Rec7003e.pdf), which sets out the frequency bands and parameters recommended primarily for telemetry, telecommand, alarms and data in general and other similar applications.

Proposed technical conditions for the 169.4–169.8125 MHz frequency band

|  |  |  |
| --- | --- | --- |
| **Band (MHz)** | **EIRP (mW)** | **Spectrum access and mitigation requirements** |
| 169.4–169.4875 | 16.4 | ≤ 0.1 % duty cycle |
| 169.4875–169.5875 | 16.4 | ≤ 0.001% duty cycle except for 00:00 h to 06:00 h local time where the duty cycle limit is ≤ 0.1% |
| 169.5875–169.8125 | 16.4 | ≤ 0.1 % duty cycle |

The VHF IoT discussion paper included a case study of IoT devices based on existing services licensed in Australia (for example, licence number 10522808/1). Devices used in low and remote density areas communicate directly with low-Earth orbit (LEO) satellites with no base stations. The remote devices are licensed to operate at:

* 8.3W (9.2 dBW) EIRP
* bandwidth of 12.5 kHz
* transmissions must not exceed 0.1% duty cycle averaged over a 24-hour period.

**International Telecommunication Union**

### ITU Resolution 248

[ITU Resolution 248 (WRC-19)](https://www.itu.int/dms_pub/itu-r/oth/0C/0A/R0C0A00000F0086PDFE.pdf) invites all administrations to participate in studies relating to narrowband MSS in 4 frequency bands, including the 2010–2025 MHz band in Region 1 (adjacent to the proposed 2005–2010 MHz band for narrowband MSS in Australia). It considers that:

… a preliminary assessment of the spectrum requirements would suggest that a pairing of no more than 5 MHz in the uplink and 5 MHz in the downlink may suffice for the applications of low data-rate systems for the collection of data from, and management of, terrestrial devices in the [MSS].

Resolution 248 also considers:

… that earth and space stations used for the applications of the systems … may include a combination of low power and intermittent transmissions to facilitate spectrum sharing and spectrum requirements …

and notes the increasing demand for MSS.

Resolution 248 indicates narrowband MSS studies should be limited to the following:

* space stations with maximum EIRP at or below 27 dBW with a maximum beamwidth of 120⁰
* earth stations that communicate individually at no more than once every 15 minutes for no more than 4 seconds at a time with a maximum EIRP of 7 dBW.

### Report ITU-R M.[MSS&IMT-ADVANCED SHARING]

Report ITU-R M.[MSS&IMT-ADVANCED SHARING] *- Coexistence and compatibility study between the terrestrial component and the satellite component of IMT in the frequency bands 1 980-2 010 MHz and 2 170-2 200 MHz in different countries (WRC-19 agenda item 9.1.1)* (Document 4C/472-E Annex 8).

[Document 4C/472-E Annex 8](https://www.itu.int/md/R15-WP4C-C-0472/en) looks at coexistence and compatibility between the terrestrial component and satellite component of IMT in the 1980–2010 MHz and 2170–2200 MHz bands. It lists ‘typical’ mobile earth station (MES) maximum EIRP density values for LEO, medium earth orbit (MEO) and geostationary orbit (GSO) as shown in Table 3.

MES characteristics

|  |  |  |
| --- | --- | --- |
| Orbit | MES type | Maximum EIRP density |
| LEO/MEO/GSO | Handset | 5 dBW/31.3 kHz |
| Portable | 12 dBW/31.3 kHz |
| Transportable | 13 dBW/31.3 kHz |
| GSO | 3G Handset | -7 dBW/21.6 kHz |
| Class 1 | 3 dBW/21.6 kHz |
| Class 2 | -3 dBW/21.6 kHz |
| Class 3 | -6 dBW/21.6 kHz |
| Portable | 5 dBW/21.6 kHz |
| Vehicular | 20 dBW/216 kHz |
| Transportable | 24 dBW/324 kHz |
| Aeronautical | 10 dBW/21.6 kHz |

Three power classes are given for MES equipped with standard omnidirectional antennas. It is assumed that portable MES are built into a notebook computer with an extended external antenna, vehicular MES have a radio frequency module on a car roof, transportable MES are a notebook computer with an integral flat patch antenna built into the cover and the aeronautical MES antenna is located on top of the fuselage.

### Draft Report ITU-R M.[NB-MSS]

*Draft Report ITU-R M.[NB-MSS] (Working document 1 relating to agenda item 1.18) - Studies relating to spectrum needs and potential new allocations to the mobile-satellite service in the frequency bands 1 695-1 710 MHz, 2 010-2 025 MHz, 3 300-3 315 MHz and 3 385-3 400 MHz for future development of narrowband mobile-satellite systems* (Document 4C/162-E Annex 9).

[Document 4C/162-E Annex 9](https://www.itu.int/md/R19-WP4C-C-0162/en) is a working document to investigate spectrum needs and potential new allocations for MSS in several frequency bands including 2010–2025 MHz for future development of narrowband MSS under WRC-23 AI 1.18. It proposes methods to implement the studies required by ITU Resolution 248.

#### Draft Report/[Recommendation] ITU-R M.[NB.MSS.COMPATIBILITY]

*Draft Report/[Recommendation] ITU-R M.[NB.MSS.COMPATIBILITY] (Working document 2 relating to WRC-23 agenda item 1.18) - Sharing and Compatibility studies for Narrowband MSS with incumbent services in the frequency bands 1 695-1 710 MHz, 2 010-2 025 MHz, 3 300-3 315 MHz and 3 385-3 400 MHz under WRC-23 agenda item 1.18* (Document 4C/162-E Annex 10).

[Document 4C/162-E Annex 10](https://www.itu.int/md/R19-WP4C-C-0162/en) is a working document to conduct sharing and compatibility studies for narrowband MSS with incumbent services in several frequency bands including 2010–2025 MHz under WRC-23 AI 1.18. Currently, there are no suggestions in the working document for services in the 2010-2025 MHz bands or adjacent bands.

### Proposed revisions to working document towards a PRELIMINARY DRAFT NEW REPORT ITU-R M.[NB-MSS]

*Proposed revisions to working document towards a PRELIMINARY DRAFT NEW REPORT ITU-R M.[NB-MSS] (WRC-23 agenda item 1.18 Resolution 248 (WRC-19))* (Document 4C/CAN-01 [XX] June 2021).

[Document 4C/CAN-01](https://www.itu.int/md/R19-WP4C.AR-C-0120/en) is the Canadian submission to AI 1.18. It considers user terminals with maximum EIRP between -7 dBW and 7 dBW and provides a link budget for a ‘LEO System N’. LEO system N is:

a constellation of up to 66 satellites serving ultra low cost, delay tolerant applications based on a scenario under study at 3GPP for Narrowband IoT via Non Terrestrial Networks.

Typical user equipment operates with a maximum transmit power of 23 dBm over an uplink bandwidth of 3.75 kHz at 2015 MHz.

**Electronic Communications Committee**

### ECC Report 305

[ECC Report 305](https://docdb.cept.org/download/4b0b3ac9-94db/ECC%20Report%20305.pdf) discusses M2M/IoT operation via satellite. It notes:

[e]xisting market studies show that the bulk of satellite M2M/IoT services are based on mobile solutions with relatively low throughputs and are predominantly deployed in MSS frequency bands below 3 GHz.

The report shows examples of current M2M terminals and small satellite transceiver modules available on the market. The report supports the possibility of narrowband MSS co-existing with adjacent-band terrestrial services, although the report does not suggest a maximum EIRP or appropriate duty cycle rate to implement narrowband MSS.

### ERC/DEC/(99)06

[ERC/DEC/(99)06](https://docdb.cept.org/document/788) (ERC Decision of 10 March 1999 on the harmonised introduction of satellite personal communication systems operating in the bands below 1 GHz (S-PCS<1GHz), amended July 2021) provides a procedure for the harmonised introduction of S-PCS <1GHz systems within CEPT countries, including principles and criteria for the identification of spectrum to be used by the MESs, as well as technical and operational constraints for each S-PCS<1GHz system to be introduced.

Annex 2 of the decision lists all systems that have satisfied the conditions of the decision with regard to compatibility, have made the successful launch and in orbit deployment of the first satellite, and are therefore to be considered by CEPT Administrations for introduction.

Characteristics of systems listed in Annex 2:

* frequency bands:
* earth-to-space: 148–150.05 MHz and 399.9–400.05 MHz
* space-to-earth: 137–138 MHz and 400.15–401 MHz
* user terminal transmitter (EIRP) power density: -6.0 dBW/4kHz to 10 dBW/4 kHz
* transmit length:
* burst length 0.5 to 4 secs
* time between bursts: 15 to 900 sec
* duty cycle: 0.3 to 1% in any 15 minutes.

### Draft ECC Report 322

The [Draft ECC Report 322 Compatibility analysis (inter-service and intra service) for S-PCS below 1 GHz](https://cept.org/ecc/tools-and-services/ecc-consultation) and an earlier [draft](https://www.cept.org/Documents/wg-se/64173/se-21-079a09_draft-ecc-report-322-wi-se40_40-compatibility-studies-to-be-conducted-according-to-erc-dec-99-06) consider new systems for inclusion into the ERC/DEC/(99)06.

Draft ECC Report 322 describes operational constraints for 2 additional systems being considered for inclusion in [ERC/DEC/(99)06](https://docdb.cept.org/document/788).

A summary of certain UHF MES IoT modules is:

* EIRP between -19.7 dBW/4kHz to 5 dBW/4kHz
* bandwidths between 4 kHz to 120 kHz
* maximum duty cycles between 0.05 to 0.5%
* frequency range 399.9–400.05 MHz.

**FCC**

### Petition RM-11869 to FCC

Petition [FCC Docket RM-11869](https://www.fcc.gov/ecfs/search/filings?proceedings_name=RM-11869&sort=date_disseminated,DESC) is before the FCC requesting that the FCC commence a process to revise its rules to expand spectrum availability for small satellites by adding MSS allocation in the frequency range 2020–2025 MHz. Technical analysis provided in the petition considered the characteristics of CubeSat satellite systems.

The petition proposed:

* downlink power flux density limits based on ITU Radio Regulations Table 21-4 for 2200–2300 MHz. That is, for angles of arrival (δ) above the horizontal plane, the following limits are applicable:
* 0⁰ to 5⁰: -154 dB(W/m2)
* 5⁰ to 25⁰: -154 + 0.5(δ - 5) dB(W/m2)
* 25⁰ to 90⁰: -144 dB(W/m2)
* maximum EIRP of 36 dBm (4 Watts)
* out-of-band emissions outside of the MSS frequency block attenuated below the total transmitter power (P) by a minimum of 43 + 10log(P) dB, ‘as measured by instrumentation employing a resolution bandwidth of one megahertz or greater’.

The technical analysis in the petition was based on:

* user terminal with typical channel bandwidth of 200-500 kHz
* primary application would be the transmission of short messages (typically <1 second transmission time, <10 times per day).

The petition used an approach based on [section 2.2 of Report ITU-R M.2041](https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-M.2041-2003-PDF-E.pdf) for evaluating interference from narrowband MSS user terminal uplink into terrestrial systems.

### FCC Equipment Authorization database

A review of the FCC [Equipment Authorization database](https://www.fcc.gov/oet/ea/fccid) was undertaken in bands between 1610–1675 MHz (bands used by L-band MSS systems). Select values are presented in the summary.

## 3rd Generation Partnership Project (3GPP)

### 3GPP TR 36.763

*3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on Narrow-Band Internet of Things (NB-IoT) / enhanced Machine Type Communication (eMTC) support for Non-Terrestrial Networks (NTN) (*[*Release 17*](https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3747)*).*

Narrowband IoT device channel bandwidth is 180 kHz (downlink) (within 200 kHz LTE band), and up to 180 kHz with all permissible smaller resource allocations 12 x 15 kHz, 6 x 15 kHz, 3 x 15 kHz, 1 x 15 kHz, and 1 x 3.75 kHz (uplink).[[13]](#footnote-13)

### 3GPP TR 38.821

*3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Solutions for NR to support non-terrestrial networks (NTN) (*[*Release 16*](https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3525)*).*

The 3GPP 5G technical specification for network radio to support non-terrestrial networks considers stationary user equipment with IoT capability operating at 2 kbps downlink and 10 kbps uplink providing low power wide area service capability, with S-band handsets operating at 200 mW (23 dBm).

**Summary of existing TOB technical parameters**

For comparison, the following parameters are contained in [RALI FX21](https://www.acma.gov.au/publications/2019-09/instruction/rali-fx21-television-outside-broadcasting-services) for TOB services:

* TOB in the 1980–2010/2170–2200 MHz bands:
* intended use is hand-held wireless video cameras
* maximum transmitter EIRP[[14]](#footnote-14) is limited to 23 dBm/8 MHz
* airborne TOB transmitters (for example, helicopters) are not permitted
* within the band 2175–2200 MHz, TOB transmitters are not to be operated within 100 kilometres of an earth station receiver operating within the band 2200–2300 MHz.
* TOB in the 2010-2110/2200-2300 MHz bands:
* a variety of platforms supported, from wireless cameras to helicopters
* no maximum transmitter EIRP
* spectrum mask: ETSI EN 300 744 (effectively – 50 dBC out of band)
* interference threshold -147.3 dBW/MHz (based on Recommendation [ITU-R F.1777-2](https://www.itu.int/rec/R-REC-F.1777/en)).

**Summary**

Table 4 provides a comparison of the technical information derived from the various references discussed.

Summary of narrowband MSS technical parameters for comparison

|  |  |  |  |
| --- | --- | --- | --- |
| Technology | Uplink (EIRP/BW) | PSD uplink (dBW/MHz) | Duty cycle |
| **3GPP** |
| S-band NB-IoT handset | 23 dBm/180 kHz23 dBm/3.75 kHz | -0.517.3 | - |
| **ACMA** |
| 900 MHz IoT | -14.5 dBm/kHz | -14.5 | 0.1% over 1 hr |
| VHF IoT | 12.1 dBm/87.5 kHz12.1 dBm/100 kHz12.1 dBm/225 kHz | -7.3-7.9-11.4 | 0.1%\* |
| VHF IoT case study | 9.2 dBW/12.5 kHz | 28.2 | Max. 0.1% over 24 hrs |
| **ECC** |
| ERC/DEC/(99)06 | -6 dBW/4 kHz10 dBW/4 kHz | 1834 | 0.3% to 1% per 15 min |
| Draft ECC 322 | 5 dBW/4 kHz-5 dBW/120 kHz3.5 dBW/120 kHz | 294.212.7 | 0.5% in 24 hrs (typ. 0.02%) and 0.05% |
| **ITU** |
| ITU Resolution 248 | 7 dBW/5 MHz | 0 | 0.44% per 15 min |
| ITU Draft reportLEO/MEO/GSO | 5 dBW/31.3 kHz12 dBW/31.3 kHz13 dBW/31.3 kHz | 202728 | - |
| Various GSO | -7 – 10 dBW/21.6 kHz 24 dBW/324 kHz20 dBW/216 kHz | 19.7 – 26.728.926.7 | - |
| AI 1.18 submission (Canada) | 23 dBm/3.75 kHz | 17.3 | - |
| **FCC** |
| Petition RM-11869 | 36 dBm/200 kHz36 dBm/500 kHz | 913 | Max. 0.01% per day |
| FCC equipment authorisation search results – L Band MSS | -6.4 dBW/333 kHz1.5 dBW/1.23 MHz5.5 dBW/1.23 MHz1.0 dBW/50 kHz7.1 dBW/41 kHz25.4 dBW/189 kHz | -1.60.64.614.021.032.6 | - |
| **TOB reference comparison** |
| TOB camera transmitter max | 23 dBm/8 MHz | -16 | - |

*\* Ignoring 0.001% maximum duty cycle specified for 169.4875–169.5875 MHz*

*\*\* Assuming I-4 channel bandwidth of 200 kHz*

1. 3rd Generation Partnership Project, Technical Specification Group Radio Access Network, Study on Narrow-Band Internet of Things (NB-IoT)/enhanced Machine Type Communication (eMTC) support for Non-Terrestrial Networks (NTN) ([Release 17](https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3747)). [↑](#footnote-ref-1)
2. Transition arrangements for the 2 GHz band are detailed in our concurrent consultation paper titled *Replanning the 2 GHz band: Review of the 2 GHz Television Outside Broadcast Frequency Band Plan*. [↑](#footnote-ref-2)
3. Proposed metropolitan and designated areas – as well as proposed spectrum availability timeframes – are defined in our concurrent consultation paper: *Review of the 2 GHz Television Outside Broadcast Frequency Band Plan*. Metropolitan areas include capital cities and surrounds. Designated areas include some sporting and event venues in non-metropolitan areas where TOB services are used regularly. [↑](#footnote-ref-3)
4. Ubiquitous FSS includes very small aperture antenna terminal (VSAT) systems, land earth stations in motion (L-ESIM), aeronautical ESIM (A-ESIM) and maritime ESIM (M-ESIM). [↑](#footnote-ref-4)
5. The defined population centres are specified at subsection 5(4) in the [Radiocommunications (Spectrum Re-allocation—26 GHz band) Declaration 2019](https://www.legislation.gov.au/Details/F2019L01374). These areas are equivalent to those specified in the tables for HCIS area descriptions set out in Radiocommunications Assignment and Licensing Instruction No. MS 26 (RALI MS 26) that apply to the 25.1–27.5 GHz frequency range. [↑](#footnote-ref-5)
6. See footnote 5. [↑](#footnote-ref-6)
7. Specifically, procedures for submission and processing of applications for [space and space receive apparatus licences](https://www.acma.gov.au/procedures-space-and-space-receive-licensing) and [earth, earth receive apparatus licences and device registrations under area-wide apparatus licences for fixed earth stations](file:///C%3A%5CUsers%5CNTomask%5CAppData%5CLocal%5CMicrosoft%5CWindows%5CINetCache%5CContent.Outlook%5C0PJ5DHPT%5Cearth%2C%20earth%20receive%20apparatus%20licences%20and%20device%20registrations%20under%20area-wide%20apparatus%20licences%20for%20fixed%20earth%20stations). [↑](#footnote-ref-7)
8. 3rd Generation Partnership Project, Technical Specification Group Radio Access Network, Study on Narrow-Band Internet of Things (NB-IoT) / enhanced Machine Type Communication (eMTC) support for Non-Terrestrial Networks (NTN) ([Release 17](https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3747)) [↑](#footnote-ref-8)
9. With TOB services using a similar modulation scheme to digital television, additional guidance can be drawn from Recommendation ITU-R BT.1368-13 (Planning criteria, including protection ratios, for digital terrestrial television services in the VHF/UHF bands), which gives protection requirements for CW/FM into digital television in the order of -3 dB wanted to unwanted (4 MHz frequency separation between channel centres) to -33 dB (5 MHz separation). [↑](#footnote-ref-9)
10. Based on a wireless camera EIRP of 23dBm/MHz (16 dBW/MHz) and an out-of-band requirement of

-50 dB. [↑](#footnote-ref-10)
11. That is, we do not intend to limit the number of space/space receive apparatus licences issued in the 2 GHz narrowband MSS segment. [↑](#footnote-ref-11)
12. Proposed metropolitan and designated areas – as well as proposed spectrum availability timeframes – are defined in our concurrent consultation paper: *Replanning the 2 GHz band: Review of the 2 GHz Television Outside Broadcast Frequency Band Plan*. Metropolitan areas include capital cities and surrounds. Designated areas include some sporting and event venues in non-metropolitan areas where TOB services are used regularly. [↑](#footnote-ref-12)
13. 3GPP TR 36.763 (2021-06), ‘Technical Specification Group Radio Access Network; Study on Narrow-Band Internet of Things (IoT) / enhanced Machine Type Communication (eMTC) support for Non-Terrestrial Networks (NTN) (Release 17)’, p. 16 [↑](#footnote-ref-13)
14. Equivalent isotropically radiated power (EIRP) [↑](#footnote-ref-14)