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

Response to submissions

JULY 2022

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Executive summary

On 17 December 2021, the Australian Communications and Media Authority commenced a public [consultation](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) on proposed arrangements to authorise use of uncoordinated earth stations 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 shared narrowband MSS segment)

the 28 GHz band in the frequency range 27.5–28.3 GHz.

To implement these arrangements, we proposed 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 draft legislative instrument accompanying the consultation – the Radiocommunications (Communication With Space Object) Class Licence Variation 2022 (No.1)(the draft variation).

We received 11 submissions to the consultation, which closed on 28 February 2022.

**2 GHz narrowband mobile-satellite services**

Eight respondents commented on the proposed licensing arrangements for 2 GHz narrowband mobile-satellite services (MSS):

Three requested reconsideration of our planning decision to introduce the 2 GHz shared narrowband MSS segment (Communications Alliance Satellite Services Working Group (SSWG) and their member organisations EchoStar Global Australia and Omnispace Australia).

Three supported the proposals (Fleet Space Technologies, OQ Technology and Sateliot), and requested no technical limits on narrowband MSS services operating in non-metropolitan areas.

The Australian Broadcasting Corporation (ABC) and Free TV Australia (Free TV) did not object to the overall proposal, but requested that technical limits be applied to narrowband MSS services operating in non-metropolitan areas to protect their adjacent-band television outside broadcast (TOB) services.

Other technical issues raised included a request for MSS ground stations to be mandated to transition to terrestrial networks where possible and alternatives to sharing the band to avoid coordination problems.

After considering the issues raised in the consultation, the ACMA made the Radiocommunications (Communication with Space Object) Class Licence Variation 2022 (No.1). There were no substantive changes to the draft variation.

However, as a result of issues raised in submissions regarding the protection of adjacent band TOB services and subsequent ACMA technical analysis, we have decided to place additional limitation on the operation of earth station transmitters in the 2005–2010 MHz band. These will include a policy (to be included in [spectrum embargo 23](https://www.acma.gov.au/publications/2019-10/rules/embargo-23)[[1]](#footnote-2)) of not allowing space receive licences in the upper 1 MHz (2009–2010 MHz), along with restrictions on earth station transmit locations and duty cycles (to be recorded in our licence assessment procedures for [space and space receive licences](https://www.acma.gov.au/publications/2020-08/guide/submission-and-processing-applications-space-and-space-receive-apparatus-licences)).

We decided to include the limitation in a spectrum embargo and leave the 1 MHz (2009–2010 MHz) in the CSO Class Licence for now, to facilitate development of revised arrangements in the event new information and/or experience with the MSS deployment indicates these frequencies may be used without causing interference to TOB.

Recognising that the arrangements restrict MSS services further than previously proposed, we are open to reviewing these arrangements if the satellite industry can provide supporting information[[2]](#footnote-3) documenting the reasons for and the benefits of such a review. However, at this stage no further work is proposed as it would delay making the band available for MSS services. If required, further work can be considered as part of work on developing arrangements in the remaining part of the 2 GHz band, which we presently intend to be subject to a price-based allocation process.

As a next step, we will update our licence assessment procedures for [space and space receive licences](https://www.acma.gov.au/publications/2020-08/guide/submission-and-processing-applications-space-and-space-receive-apparatus-licences) to give effect to new licensing procedures for 2 GHz narrowband MSS and [Embargo 23](https://www.acma.gov.au/publications/2019-10/rules/embargo-23) (to include the limitation on 2009–2010 MHz). Consequential updates will also be made to ACMA planning instruments [RALI FX21](https://www.acma.gov.au/publications/2019-09/instruction/rali-fx21-television-outside-broadcasting-services) (television outside broadcasting services) to reflect TOB transition timelines.

The 2 GHz narrowband MSS segment is intended to become available for use under a phased implementation approach, once the licence assessment procedures and ACMA planning instruments have been updated, as follows:

Until 29 February 2024, use is permitted only outside of metropolitan areas and designated areas on the basis of no protection afforded from and no interference to TOB services.

From 1 March 2024 until 28 February 2026, use is still permitted only outside of metropolitan areas and designated areas, but there are no conditions in relation to TOB services.

From 1 March 2026, use is permitted Australia-wide (including in metropolitan and designated areas).

These timeframes and conditions are set out in the Radiocommunications (Mobile-Satellite Service) (1980–2010 MHz and 2170–2200 MHz) Frequency Band Plan 2022. Operation in metropolitan and designated areas is not to commence before 1 March 2026.

1. **GHz fixed-satellite services**

Four respondents commented on the proposed licensing arrangements for 28 GHz band ubiquitous fixed-satellite services. While all four respondents (SSWG, NBN Co, Telesat and Viasat) supported the inclusion of arrangements for ubiquitous fixed satellite services (FSS) in the 27.5–28.3 GHz frequency range, the respondents suggested:

* allowing the operation of ubiquitous Very Small Aperture Terminals (VSATs) inside defined population centres within 27.5–28.1 GHz
* using an onshore power flux density (PFD) limit of -91 dBW/m2/MHz for maritime earth stations in motion (ESIM), instead of the proposed ‑112.2 dBW/m2/MHz
* allowing operation from gate-to-gate for both aeronautical and maritime ESIM
* using unwanted emission limits criteria to manage adjacent band coexistence at the 28.1 GHz frequency boundary instead of using the guard bands as proposed
* adopting Australian-defined PFD limits for aeronautical ESIM based on European Communications Committee (ECC) criteria instead of International Telecommunications Union – Radiocommunications (ITU-R) Resolution 169 criteria
* proposing new PFD limits for aeronautical ESIM

clarifying the use of non-geostationary orbit (NGSO) VSATs in the 28 GHz band.

The majority of these issues have been previously addressed in correspondence from the ACMA to the satellite industry as part of informal preliminary consultation on the matter. After considering the issues raised in the consultation, the ACMA made the Radiocommunications (Communication with Space Object) Class Licence Variation 2022 (No.1). There were no substantive changes to the draft variation.

As a next step, we will update our licence assessment procedures for [space and space receive licences](https://www.acma.gov.au/publications/2020-08/guide/submission-and-processing-applications-space-and-space-receive-apparatus-licences) to include arrangements for the 28 GHz band.

# Introduction

## Background

On 17 December 2021, the Australian Communications and Media Authority commenced a public [consultation](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) on proposed arrangements to authorise use of uncoordinated earth stations 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 shared narrowband mobile-satellite services (MSS) segment)

the 28 GHz band in the frequency range 27.5–28.3 GHz.

To implement these arrangements, we proposed 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 draft legislative instrument accompanying the consultation – the Radiocommunications (Communication with Space Object) Class Licence Variation 2022 (No.1)(the draft variation).

## Submissions

The consultation closed on 28 February 2022. We received 12 submissions from the following organisations:

ABC

Australian Subscription Television and Radio Association

Communications Alliance SSWG

EchoStar Global Australia

Fleet Space Technologies

Free TV

NBN Co

Omnispace Australia

OQ Technology (confidential)

Sateliot (confidential)

Telesat

Viasat Australia.

With the exception of 2 confidential submissions, these are available on the [ACMA website](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).

Since there is no overlap between proposals for the 2 GHz shared narrowband MSS segment and 28 GHz bands, the issues raised by respondents in each band are considered in turn below.

# 2 GHz shared narrowband MSS segment

## Overview

Eight respondents commented on the proposed licensing arrangements for the 2 GHz shared narrowband MSS segment:

Three requested reconsideration of the ACMA’s planning decision to introduce the 2 GHz shared narrowband MSS segment (Communications Alliance SSWG and their member organisations, EchoStar Global Australia and Omnispace Australia).

Three supported the proposals (Fleet Space Technologies, OQ Technology and Sateliot), and requested no technical limits on narrowband MSS services operating in non-metropolitan areas.

Two from the broadcasting industry (ABC and Free TV) did not object to the overall proposal but requested that technical limits be applied to narrowband MSS services operating in non-metropolitan areas to protect their adjacent-band television outside broadcast (TOB) services.

Other technical issues raised included a request for MSS ground stations to be mandated to transition to terrestrial networks where possible, and alternatives to sharing the band to avoid coordination issues. We address these issues in turn below.

## Issues

### Reconsideration of planning decision

The 3 respondents opposing the proposal to introduce the 2 GHz shared narrowband MSS segment re-prosecuted proposals to plan the entire 2 GHz band (2 x 30 MHz) for exclusively-licensed MSS.[[3]](#footnote-4) They argued that allocation of this shared narrowband segment would create a unique Australian arrangement, generate challenges for global satellite IoT providers, and result in ‘wasted spectrum’.

#### ACMA response

Our decision to replan part of the 2 GHz band for shared narrowband MSS was announced in the 2 GHz [outcomes paper](https://www.acma.gov.au/consultations/2020-07/replanning-options-2-ghz-band-consultation-232020) in January 2021. As noted in that paper, this 2 x 5 MHz segment is required as a restricted band (guard band) providing protection to adjacent-band TOB services. The envisaged restrictions were considered to limit the usability of the band by typical MSS, thereby impacting the viability of providing services. Analysis at Appendix A confirms that restrictions are required. Considering views expressed by respondents, the restrictions will limit operational areas and the range of user terminals that can be supported.

As expressed in the 2 GHz outcomes paper, our view is that these restrictions require a different approach to licensing and use. Accordingly, we made the decision to repurpose this segment for use by low-powered, low-duty-cycle MSS on a shared basis. This approach also provides the opportunity for arrangements with a low barrier to entry supporting innovative satellite applications. It is intended to provide opportunities for new entrants and support growth in the Australian space industry.

However, as with any satellite service, viability is in part dependent on the status of the satellite network in the International Telecommunication Union (ITU) satellite coordination process, which is the responsibility of the satellite operator to manage. While we acknowledge that ITU satellite coordination requirements might limit the utility of these arrangements for new entrants both inside and outside of Australia, we consider there is a benefit in providing opportunities for new entrants in Australia that may support growth of the Australian space industry.

We have decided to proceed with implementing arrangements to support shared use of the band. Licensees will be expected to both coordinate with other licensees and operate in accordance with the ITU satellite coordination process (including operating in accordance with any agreement made between Administrations).

### Technical limits

One respondent objected to the proposed limits in metropolitan areas as they are significantly lower than the maximum provided by 3GPP, and the respondent would be unable to provide a meaningful service within the limits due to an inability to close the link budget.[[4]](#footnote-5)

The satellite operators that supported the proposals are opposed to any imposition of technical limits for MSS operating outside of metropolitan areas, suggesting this would impose a regulatory barrier to entry and is unnecessary given the low probability of interference from low power internet of things (IoT) deployments.

The ABC and Free TV did not object to the overall proposal but recommended that the technical limits proposed for metropolitan areas be applied Australia-wide. This would mitigate the risk of interference to TOB services operated in the adjacent band by free-to-air broadcasters in regional areas.

#### ACMA response

Our analysis at Appendix A indicates that some additional restrictions are required in both metropolitan and non-metropolitan areas, but not all are required Australia wide. The results are summarised below.

Single-interferer (worst-case) separation distances required are manageable: approximately 0.75 km to a mobile TOB receiver and 1.5 km for high gain TOB receivers).

Small separations are required between multiple earth stations and mobile receivers (up to 5 km in cases of dense earth station deployment and unfavourable terrain).

High gain TOB receivers are susceptible to interference from large numbers of earth stations. There are a number of TOB receiving sites outside of metropolitan areas. The potential for interference to fixed TOB receivers can be managed by limiting the number of concurrently transmitting narrowband MSS devices with line-of-sight to the receiver via a duty cycle requirement (for some high gain receivers, this distance can be up to 120 km).

Sharing near the 2010 MHz band edge is challenging, and frequency separation between the adjacent TOB band and MSS is required.

To facilitate sharing (and manage the potential for interference), in addition to conditions in the CSO Class Licence, the following requirements will be implemented in updates to the policy contained in the relevant [business operating procedure](https://www.acma.gov.au/sites/default/files/2021-04/BOP%20space%20and%20space%20receive_0.pdf) (BOP)[[5]](#footnote-6):

Earth stations transmit equivalent isotropic radiated power (EIRP) limited to -7 dBW, and bandwidth must be at least 3.75 kHz (note that the CSO Class Licence will keep the proposed EIRP spectral density limit in metropolitan areas).

Earth stations will not be permitted to transmit within 10 km of TOB collection points (listed below, and in the relevant BOP).

The 2009–2010 MHz portion of the band will not be available for space receive licences (that is, no uncoordinated earth station transmitters will be supported in this frequency range).

Outside of metropolitan areas:

devices meeting the metropolitan area EIRP spectral density may operate at up to a duty cycle of 10%

for devices operating with EIRP spectral densities above the metropolitan area limit:

if the device is within certain distances of TOB sites (120 km from a listed high gain site and 20 km from a listed moderate gain site), it will not be permitted to exceed a duty cycle of 1%

if the device is beyond the distances in the point above from TOB sites, it will not be permitted to exceed a duty cycle of 10%.

### Protection of TOB main collection (receiving) sites

Submissions from the TOB industry expressed concern about the protection of adjacent band TOB services that operate in the bands 2010–2110 MHz and 2200–2300 MHz. A particular concern was the protection of 26 main TOB collection (receiving) sites around Australia, predominantly in metropolitan areas.

#### ACMA response

We have further studied the potential for interference from MSS to adjacent band TOB services (see Appendix A). This analysis used the protection requirements for TOB collection stations as specified in [RALI FX21](https://www.acma.gov.au/publications/2019-09/instruction/rali-fx21-television-outside-broadcasting-services). With spectrum arrangements only supporting earth station transmitters in 1980–2010 MHz[[6]](#footnote-7), it is the 2010 MHz band edge that is of key concern; Network 10 operates immediately adjacent to that edge (2010–2034 MHz).

We are imposing additional restrictions to ensure protection of the adjacent band TOB services. These include not supporting MSS in 2009–2010 MHz and placing restrictions on MSS earth stations within 120 km of 24 high gain TOB collection (receiving) sites.

Compliance with these requirements would be assessed when applicants apply for a space receive licence (note that authorisation of a radiocommunications device under the CSO Class Licence requires the device to communicate with a station on a space object authorised by a space licence or space receive licence). As under current arrangements the location of TOB collection stations in the bands 2010–2110 MHz and 2200–2300 MHz is not required to be recorded in the Register of Radiocommunication Licences, a list of TOB collection sites will be included in the ACMA assessment procedures for space and space receive licences. The list is based on the location of collection stations as registered in [the 2.5 GHz Mid Band Gap](https://web.acma.gov.au/rrl/spectrum_search.show_table?pSV_ID=85&pSS_ID=872) spectrum licences.

Our view is that these requirements support protection of TOB services as they are based on reasonable (if not conversative) assumptions about MSS performance. ACMA assessment procedures for space licences and space receive licences will require applicants to demonstrate their operation will meet those requirements. This will include mechanisms to manage limitations on devices as they transition from one area to another (for example, geofencing or network control functionality).

### Transition of MSS to terrestrial wireless broadband networks

One submission suggested that the non-availability of terrestrial wireless broadband might make for a more appropriate geographical boundary for higher power, higher duty-cycle devices than the ‘metropolitan area’ boundaries currently proposed. This respondent also requested that MSS ground stations be required to transition to terrestrial networks where possible.

#### ACMA response

We recognise the likely area separations of the 2 services and there will likely be a preference for low data rate applications to use terrestrial networks (rather than satellite) in many cases. It is, however, considered an unnecessary intervention to mandate terrestrial use where possible, and one that may limit innovation.

It is further noted that the lack of a defined set of areas where terrestrial networks are available is problematic when using this as a condition of operation, and that some areas of limited terrestrial coverage may occur in metropolitan areas.

### Alternatives to sharing between MSS operators

If the ACMA proceeds with the shared narrowband segment, Omnispace recommended relaxing the proposed technical limits to better align with 3GPP technical parameters for the band.[[7]](#footnote-8) Omnispace also suggested that sharing this segment is unworkable unless the band is divided into 5 exclusively-licensed segments.

#### ACMA response

We consider coexistence between satellite systems is a matter for industry to self-manage, noting that the ITU satellite coordination framework places an obligation on a satellite operator to ensure protection of services outside of Australia, which might also place limitations on the operation of devices in Australia.

While observing frequency sharing is a common spectrum-management practice, we consider that mandating exclusive blocks in this band has the potential to limit flexibility. Instead, our preference is that operators self-coordinate access to the band, for their system needs and characteristics. This may be in 4 bands of 1 MHz, however other methods of sharing remain possible (for example, smaller non-contiguous bands totalling 1 MHz per operator, limiting the number of devices or time division sharing).

## Consultation outcome and next steps

On 30 June 2022, the ACMA made the [Radiocommunications (Communication with Space Object) Class Licence Variation 2022 (No.1)](https://www.legislation.gov.au/Details/F2022L00937). This is available on the Federal Register of Legislation.

As a next step, we will update the BOP for [space and space receive licences](https://www.acma.gov.au/publications/2020-08/guide/submission-and-processing-applications-space-and-space-receive-apparatus-licences) to give effect to new licensing procedures for 2 GHz narrowband MSS and [Embargo 23](https://www.acma.gov.au/publications/2019-10/rules/embargo-23) (to include the limitation on 2009–2010 MHz). The BOP will be updated to require applicants for space licences and space receive licences to provide information that the proposed services will meet the conditions of the CSO Class Licence.

Consequential updates will be also made to ACMA 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 reflect TOB transition timelines.

The 2 GHz narrowband MSS segment is intended to become available for use under a phased implementation approach.

Once the licence assessment procedures and planning instruments have been updated, 2 GHz narrowband MSS services will be permitted outside of metropolitan areas and designated areas, as defined in the Radiocommunications (Mobile-Satellite Service) (1980–2010 MHz and 2170–2200 MHz) Frequency Band Plan 2022. Operation in metropolitan and designated areas is not to commence before 1 March 2026.

### Protection of TOB services during the transition period

During the transition of the 2 GHz band from TOB to MSS, the operation of MSS will be restricted to protect TOB services in the transition to new arrangements.

MSS and TOB transitional arrangements in the 2 GHz band

|  |  |  |
| --- | --- | --- |
| Area | Service | Requirement |
| Metropolitan areas and designated areas[[8]](#footnote-9) | 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. |

In recognition that the arrangements further restrict MSS services than previously proposed, we are open to reviewing these arrangements if the satellite industry can provide supporting information[[9]](#footnote-10) documenting the reasons for and the benefits of such a review (for example, 2009–2010 MHz has been retained in the CSO Class Licence in case new information or experience with the MSS deployment indicate these frequencies may be used without causing interference to TOB). However, at this stage, no further work is proposed as it would delay making the band available for MSS services. If required, further work could be considered as part of developing arrangements in the remaining part of the 2 GHz band, which we presently intend to be a price-based allocation process.

# 28 GHz fixed-satellite services

## Overview

Four submitters commented on the proposed licensing arrangements for 28 GHz band ubiquitous FSS. While all 4 submitters (SSWG, NBN Co, Telesat and Viasat) supported including arrangements for ubiquitous FSS in the 27.5–28.3 GHz frequency range, the respondents raised the following issues:

* Based on an NBN Co study, NBN Co, Viasat and the SSWG proposed allowing the operation of ubiquitous VSATs inside defined population centres within 27.5–28.1 GHz.
* For maritime ESIM, all 4 submissions proposed using an onshore PFD limit of -91 dBW/m2/MHz, instead of the proposed ‑112.2 dBW/m2/MHz.
* Viasat proposed allowing operation from gate-to-gate for both aeronautical and maritime ESIM.
* All 4 submissions proposed using unwanted emission limits to manage adjacent band coexistence at the 28.1 GHz frequency boundary instead of using the guard bands as proposed.
* Viasat proposed that the ACMA adopt Australian-defined PFD limits for aeronautical ESIM based on ECC criteria and should not adopt ITU-R Resolution 169 criteria.
* SSWG proposed new PFD limits for aeronautical ESIM.

SSWG, Telesat and Viasat asked for clarification on the use of NGSO VSATs in the 28 GHz band.

The majority of these issues have been previously addressed in correspondence from the ACMA to the satellite industry, through the SSWG. We discuss these issues in turn below.

## Issues

### Reconsider including arrangements for ubiquitous VSATs inside defined population centres within 27.5–28.1 GHz

To determine the potential planning arrangements for the 28 GHz band, we conducted a comprehensive study investigating potential interference between services, [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). Following this, NBN Co also conducted a study considering the use of VSATs inside defined population centres within 27.5–28.1 GHz, which examined the potential interference to fixed wireless access (FWA) services. Taking both studies into account, we concluded that VSATs posed an unacceptable risk to FWA and provision for ubiquitous VSATs would not be included in the planning arrangements inside defined population centres within 27.5–28.1 GHz.

In their submissions, NBN Co, Viasat and the SSWG proposed that the ACMA reverse this decision and include provision for VSATs inside defined population centres within 27.5–28.1 GHz based on the NBN Co study.

#### ACMA response

The submissions to this consultation to include provision for use of VSATs inside defined population centres within 27.5–28.1 GHz did not provide any new supporting evidence for us to reconsider our position. Our response to the satellite industry provided our consideration of the issue (see Appendix B). We will maintain our initial decision, as consulted on, to not include arrangements for ubiquitous VSATs inside defined population centres within 27.5–28.1 GHz.

### Adopt a power flux density limit of -91 dBW/m2/MHz for maritime ESIM

All 4 submissions proposed adopting an onshore PFD limit of -91 dBW/m2/MHz, instead of the proposed ‑112.2 dBW/m2/MHz for maritime ESIM. This alternative was proposed as it is the PFD value FWA services are required to meet at the boundary of their area wide licences (AWLs), in accordance with RALI MS 46 and the Radiocommunications Licence Conditions (Area-Wide Licence) Determination 2020.

#### ACMA response

The proposal to use a PFD of -91 dBW/m2/MHz has previously been raised and we have provided a detailed response to the satellite industry, see Appendix B. For FWA-to-FWA coordination, as the base stations can synchronise, the dominant interference scenario is from FWA base station to FWA user equipment. In this scenario, an I/N of ‑6 dB and an antenna gain of 0 dBi was used. For ubiquitous FSS to FWA coordination, as the services cannot synchronise, the dominant interference scenario is from FSS earth station to FWA base station. In this scenario, an I/N of 0 dB and an antenna gain of 27.2 dBi (29 dBi minus feeder losses) was used. It should be noted that both scenarios are actually protected to the same equivalent value of ‑85 dBW/m2/MHz.

For these reasons, we will maintain the use of an onshore PFD limit of ‑112.2 dBW/m2/MHz for maritime ESIM, as consulted on.

### Gate-to-gate operation for aeronautical and maritime ESIM

Viasat indicated support for ubiquitous FSS arrangements to cater for gate-to-gate and pier-to-pier operation for aeronautical and maritime ESIM, respectively. Viasat stated that it would be desirable for their networks to have the ability operate gate-to-gate and pier-to-pier.

#### ACMA response

The ACMA considered the use of ubiquitous FSS use in defined population areas in its initial study, [*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). The issue has previously been raised and we provided a detailed response to the satellite industry, see Appendix B. The interference concern is the inability for an ESIM to meet the required PFD of ‑112.2 dBW/m2/MHz to protect FWA base stations. Due to the operational nature of aeronautical ESIM (that is, communicating with a satellite), when an aeronautical ESIM is airborne, it operates above an FWA base station and thus benefits from the increased attenuation due to antenna discrimination. However, when an aeronautical ESIM has landed, it does not benefit from any increased attenuation. Therefore, we proposed licensing arrangements to only allow aeronautical ESIM to operate while airborne. Similarly for maritime ESIM, we proposed licensing arrangements that allow maritime stations to operate at any location, provided they meet the requirement of a PFD of ‑112.2 dBW/m2/MHz onshore in defined areas between 27.5–28.1 GHz.

For these reasons, we will maintain the implementation of our planning decisions on the operation of ubiquitous FSS in defined population centres, as consulted on.

### Use of unwanted emission criteria to manage adjacent band coexistence

All 4 submissions indicated their preference to not use a guard band to manage adjacent band coexistence. SSWG proposed using unwanted emission criteria to manage adjacent band coexistence at 28.1 GHz, instead of the guard bands proposed. Using unwanted emission criteria would be less onerous on licensees and would be potentially more spectrally efficient.

#### ACMA response

We considered adjacent band coexistence in our initial study, [*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). The issue has previously been raised and a detailed response provided our consideration of the issue, see Appendix B.

The use of unwanted emission criteria is a regularly used method in spectrum management; however, in this scenario it would not have provided an optimal solution. With the adjacent band coexistence between FWA and ubiquitous FSS, there are 2 interference mechanism that were considered:

the unwanted emissions from ubiquitous FSS interfering with FWA receivers

the adjacent channel selectivity of the FWA receiver.

As the adjacent channel selectivity of the FWA receiver is the dominant mechanism, using unwanted emission criteria to manage adjacent channels would not decrease the required guard band of 50 MHz but would place the required frequency separation on the FWA device. That is, the guard band would be effectively between 28.05–28.1 GHz. Given the amount of spectrum already provided to class-licensed ubiquitous FSS of 1.2 GHz, and the proposed amount of spectrum of 600 MHz for apparatus-licensed FWA, we decided to impose the required guard band above the 28.1 GHz boundary.

For these reasons, we will maintain the use of a guard band as consulted on, to ensure effective adjacent band operation.

### Aeronautical ESIM to adopt ECC criteria instead of ITU-R Resolution 169 criteria

In previous submissions to the ACMA, Viasat indicated that ACMA should not use the ITU-R Resolution 169 criteria but instead use the criteria adopted by Europe. This direction was based on Viasat’s assertion that the ITU-R Resolution 169 criteria was arbitrarily constructed to gain agreement at WRC-19. In Viasat’s submission to the consultation, it proposed that the ACMA adopt Australian-defined PFD limits for aeronautical ESIM based on ECC criteria and should not adopt ITU-R Resolution 169 criteria.

#### ACMA response

We considered Viasat’s previous submission and reviewed the use of ITU-R Resolution 169 criteria, see Appendix B. In the review of ITU-R Resolution 169 criteria and ECC criteria, we identified that:

ITU-R Resolution 169 criteria below 3 km was not used by the ECC

ITU-R Resolution 169 criteria above 3 km was the same criteria used by ECC.

We reviewed our initial analysis using the ECC criteria (noting this is the same criteria as specified in ITU-R Resolution 169 criteria for above 3 km). The outcome of this review was the ECC criteria could be supported for airborne aeronautical ESIM operation. We chose to reference ITU-R Resolution 169 criteria as the ITU is the international body for radiocommunications.

Based on these reasons, we will maintain the criteria for the operation of aeronautical ESIM as consulted on.

### Alternative aeronautical ESIM criteria

The SSWG submission proposed new PFD limits for aeronautical earth stations in motion. These limits are based on adopting the proposed PFD of -91 dBW/m2/MHz (to protect FWA services) and amending the ITU-R Resolution 169 criteria based on the difference between the 2 levels.

#### ACMA response

In previous submissions from the SSWG to the ACMA, the SSWG argued for the adoption of ECC criteria (that is, ITU-R Resolution 169 criteria above 3 km). We investigated and agreed to this proposition, see Appendix B. The new criteria provided by SSWG in the consultation on the draft variation to the CSO Class Licence had no supporting evidence for the adoption of these new criteria. These criteria have not been shared with industry members nor has any analysis been conducted to determine its viability.

For these reasons, we will maintain the criteria for the operation of aeronautical ESIM as consulted on.

### NGSO VSAT criteria

The SSWG, Telesat and Viasat asked if the use of NGSO VSAT could be considered in the 28 GHz band.

#### ACMA response

The operational criteria for ubiquitous FSS in the CSO Class Licence do not specify ubiquitous FSS earth station communication with either geostationary (GSO) or NGSO. Ubiquitous FSS earth stations can communicate with either GSO or NGSO provided they meet the requirements as specified in the CSO Class Licence.

As a next step, we will update our licence assessment procedures for [space and space receive licences](https://www.acma.gov.au/publications/2020-08/guide/submission-and-processing-applications-space-and-space-receive-apparatus-licences) to include arrangements for the 28 GHz band.

# Appendix A: 2 GHz technical analysis

The December 2021 [consultation](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) paper contained the results of a literature review of potential MSS characteristics and proposed sharing parameters to facilitate sharing with other services (such as TOB). In response to comments made during that consultation, this appendix contains the key findings of an additional study that was performed to assess the potential of narrowband MSS earth stations to interfere with TOB services.

## Narrowband MSS characteristics

### Power levels in consultation response

Some responses to the consultation indicated the power level proposed in the Draft Radiocommunications (Communication with Space Object) Class Licence Variation was too low.

One submission indicated an EIRP power of up to -10 dBW in 3.75 kHz was required to close a link budget referencing 3GPP TR 36.763. The power characteristics of 3GPP TR 36.763 (version V17.0.0 (2021-06)) are shown in Table 2.

3GPP technical details for further analysis

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Notes |
| Power | 23 dBm  20 dBm | Class 3  Class 5  From Table 6.1-1 |
| Bandwidth | 180/15/3.75 kHz | From Table 6.1-1 and 6.2.1  Up to 180 kHz with all permissible smaller resource allocations 12\*15 kHz, 6\*15 kHz, 3\*15 kHz, 1\*15 kHz, 1\*3.75 kHz |

A note on page 22 of 3GPP TR 36.763 details that many contributors used class 5 power for their simulation, though some used class 3. Class 3 powers are used in further studies, as this level is more likely to cause interference (or cause interference with less devices).

### Emission masks

ITU-R [Recommendation M.1343-1](https://www.itu.int/rec/R-REC-M.1343/en) (06/05) ‘Essential technical requirements of mobile earth stations for global non-geostationary mobile-satellite service systems in the band 1-3 GHz’ has been used to develop an MSS emission mask.

The mask generated from this recommendation is used in calculating frequency-dependant rejection values for assessing sharing compatibility with adjacent TOB services.

## Technical parameters to assess protection of TOB in adjacent band

### Protection ratio considerations

A literature review did not identify protection requirements for TOB services from narrowband MSS stations in adjacent bands. The following methodologies for assessing the potential impact were identified for further consideration:

protection ratios for TOB into TOB in adjacent bands (RALI FX21)

continuous-wave (CW) signals into TOB (ITU-R Recommendation BT.1368)

frequency dependant rejection (ITU-R Recommendation SM.337).

### Consideration of NBMSS as per TOB transmitters

One method to consider the interference potential of a number of NBMSS stations is to sum the power of a collection of stations and to consider this similar to how a single TOB transmitter would be considered.

RALI FX 21 contains a minimum wanted signal strength and a protection ratio of -30 dB in the first adjacent channel (2002–2010 MHz for the lowest TOB channel).

### Protection of TOB from continuous wave sources

Protection ratios for various services sharing with television services are provided in Recommendation ITU-R BT.1368-13 (2017). Table 26 of the Recommendation provides protection ratios for continuous wave or FM carrier in VHF/UHF bands. The table is reproduced below for convenience.

There is a degree of similarity between a 200 kHz FM interferer to a television signal in UHF bands and a narrowband MSS emission into a TOB signal in S band.

Protection ratios for televisions signals in the presence of potential interference from CW sources

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Unwanted signal: CW or FM carrier | Wanted signal: DVB-T, 8 MHz, 64-QAM, code rate 2/3 | | | | | | |
| D *f* (MHz) | −12 | −4.5 | −3.9 | 0 | 3.9 | 4.5 | 12 |
| PR | −38 | −33 | −3 | −3 | −3 | −33 | −38 |

Note: 2010 MHz band edge represents a frequency separation (D f) of 4 MHz.

Applying these values to an 8 MHz TOB channel with a centre frequency at 2014 MHz provides protection ratios of between -33 to -36 dB below 2009.5 MHz (that is, the -4.5 MHz offset in Table 3), depending on frequency offset. This is similar to the -30 dB adjacent channel protection ratio in RALI FX 21. The protection ratio increases significantly near the 2010 MHz band edge, which suggests a need for consequential limitations on the ability to operate earth stations in the 2009.5–2010 MHz band without impacting TOB.

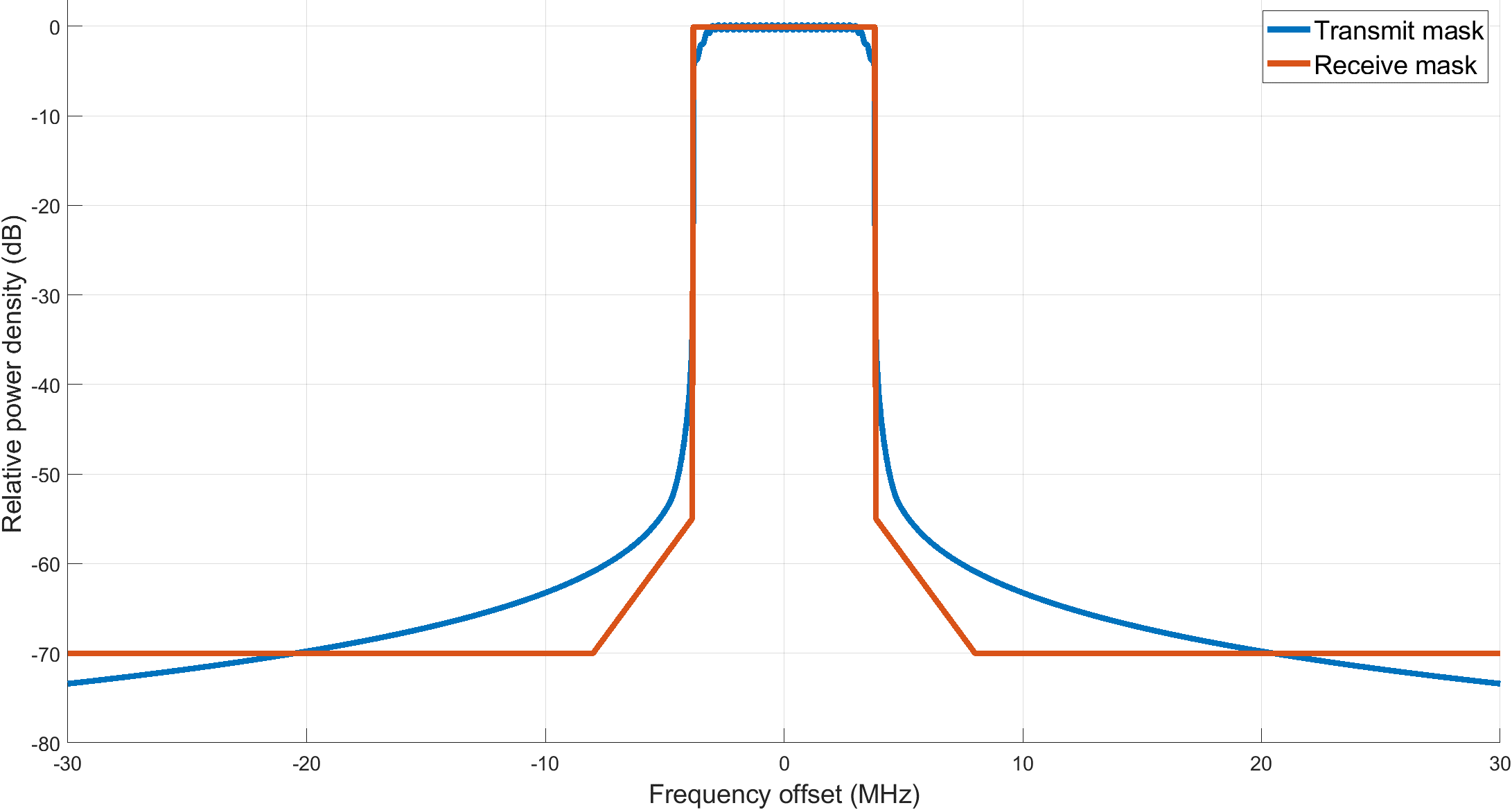
Noting the protection ratio at 2009.5, above, and the frequency dependent rejection (FDR) between 2009–2010 MHz (discussed below, including Figure 3), uncoordinated stations between 2009 and 2010 will not be facilitated at this stage.

### Developing a frequency dependant rejection value

A method for calculating FDR is described in ITU-R Recommendation SM.337. FDR is a measure of the interference coupling mechanism between interferer and receiver, which is useful for interference evaluations.

A TOB transmitter mask was modelled based on the power sum of subcarriers, using parameters from standard ETSI EN 300 744 V1.6.2 (2015-10). A TOB receiver mask was estimated based on transmitter mask and the principles of ETSI TR 101 854 V2.1.1 (2019-04). Figure 1 shows the TOB transmitter and receiver masks used in the FDR analysis.

TOB transmit and receive masks



As noted above, emission masks for narrowband MSS have been derived from ITU-R Recommendation M.1343. These are based on the out-of-band limits of Table 5 of the Recommendation, as shown in Table 4.

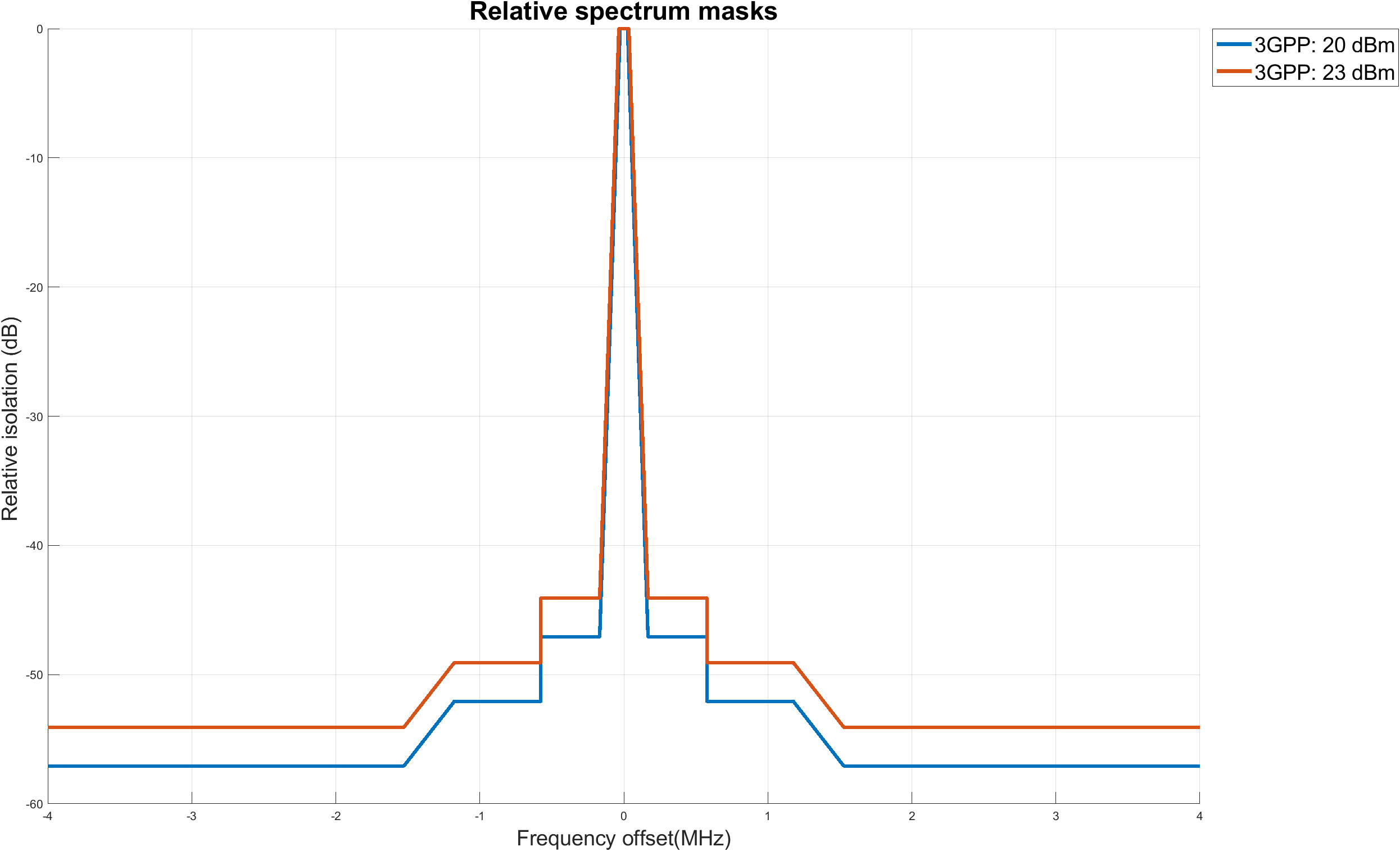
ITU-R Rec M.1343 out-of-band limits

|  |  |  |
| --- | --- | --- |
| Frequency offset (kHz) | EIRP (dBW) | Measurement bandwidth (kHz) |
| 0 to 166 | 0-(offset × 55/166) | 3 kHz |
| 166 to 575 | -55 | 3 kHz |
| 575 to 1175 | -60 | 3 kHz |
| 1175 to 1525 | –50-((offset-1 175) × 5/350) | 30 kHz |
| 1525 to 45 000 | -55 | 30 kHz |

#### FDR calculations

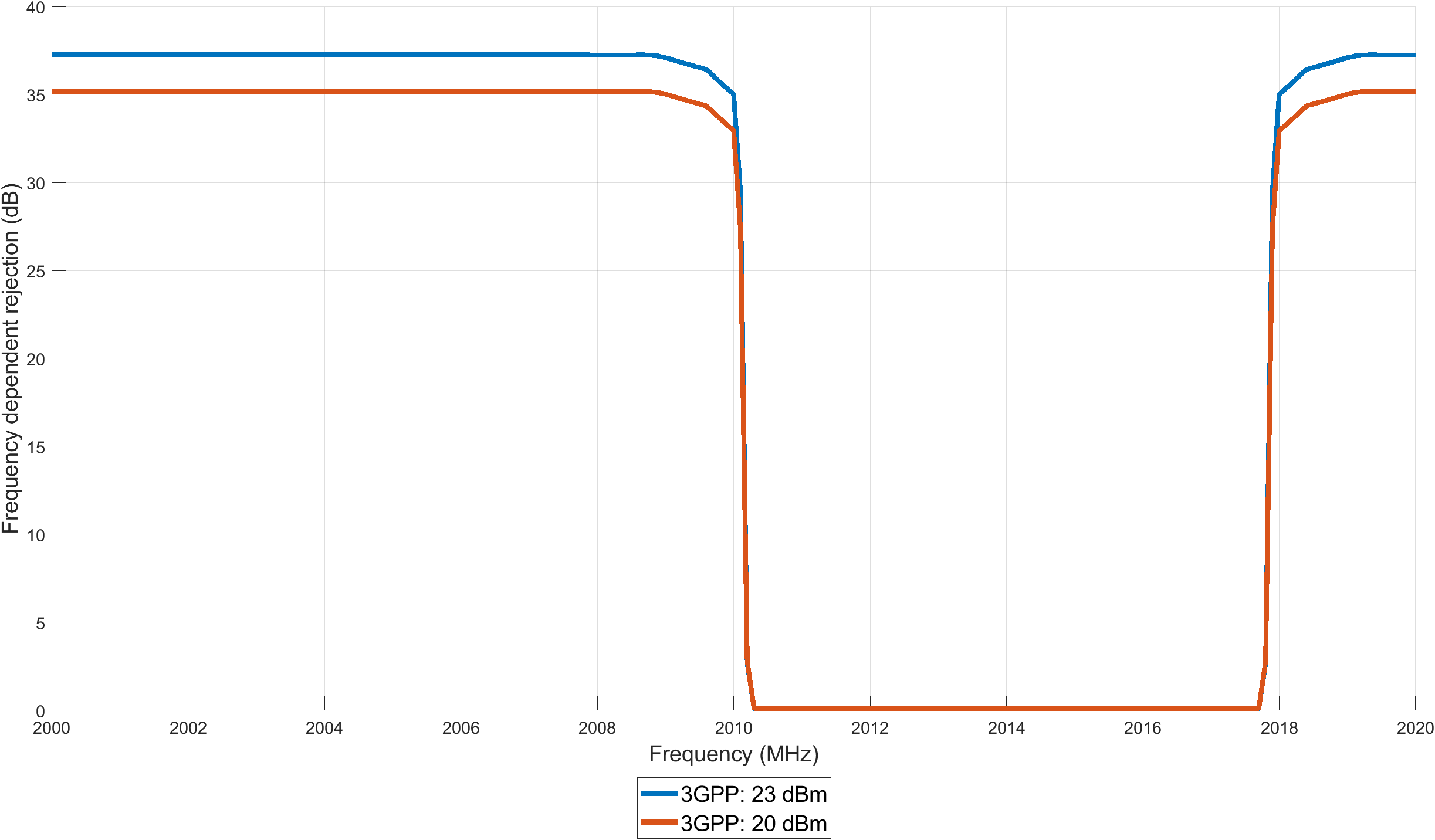
Masks were generated for the 2 3GPP power levels and used for FDR calculations. These masks are shown in Figure 2.

Transmitter masks modelled using out of band limits from ITU-R Rec. ITU-R Rec. M.1343



The results of the FDR calculations are shown in Figure 3 and summarised in Table 5, below.

FDR results using M series mask



For the 3GPP parameters listed above, the models provided the results in Table 5 at the lower end of the band under consideration.

FDR values

|  |  |
| --- | --- |
| 3GPP power level | Approximate FDR value (2005–2009 MHz) |
| 23 dBm | 37 |
| 20 dBm | 35 |

## Interference scenarios

### Single entry, mobile receiver case

Two locations were considered to conduct interference studies to a low TOB receiver (a van). These locations had differing terrain characteristics:

location 1: Beaconsfield, Tasmania (undulating terrain)

location 2: Menindee Lakes, New South Wales (flat terrain).

Figure 4 is a schematic representation of the interference scenario, where a wireless camera is transmitting to a TOB vehicle in the vicinity of earth station. The coordinates for the earth station modelled are randomly chosen (within 4 km of the TOB vehicle).

Schematic representation of the interference scenario

![Diagram, engineering drawing

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RD0RXhpZgAATU0AKgAAAAgABAE7AAIAAAAOAAAISodpAAQAAAABAAAIWJydAAEAAAAcAAAQ0OocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEthbXJhbiBTYWxlZW0AAAWQAwACAAAAFAAAEKaQBAACAAAAFAAAELqSkQACAAAAAzU3AACSkgACAAAAAzU3AADqHAAHAAAIDAAACJoAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Parameters used in single entry study

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Notes |
| Earth stations antenna gain | 0 dBi | Table 6.1-1: IoT NTN reference scenario parameters |
| Bandwidth | 3.75 kHz |
| Earth station power | -7 dBW |
| Earth station height | 2 m |  |
| TOB receiver gain | 19 dBi | Report BT. 2069 Table 19 (Yagi) |
| TOB receiver height | 10 m | RALI FX21 |
| Interference threshold | -82.3 dBW (in 8 MHz) | RALI FX 21 |
| Propagation model | ITU-R P.526 | Propagation by diffraction |

The interference threshold is estimated from a minimum wanted signal level from RALI FX 21 of -112.3 dBW (in 8 MHz) and an adjacent channel protection ratio of -30 dB. The -30 dB protection ratio is the most applicable value (of the protection ratios detailed above) to this sharing scenario and is also the most conservative.

This scenario considers a single interfering earth station (with a bandwidth of <200 kHz) contributing all of the interference threshold (that is, this scenario does not consider the effects of multiple interferers or duty cycle[[10]](#footnote-11)) to a nearby mobile receiver (van).

Simulations were performed in [Visualyse Professional](https://www.transfinite.com/content/professional), and considered both the interference level received and impacts on a wanted link.

Results from the simulations (both locations) show that a single earth station more than 0.7 km from a TOB van will not cause unacceptable levels of interference for the TOB system.

### Single entry, high gain receiver

The mobile receiver in the case above can be replaced with a high gain[[11]](#footnote-12) receiver. In this case, the TOB receiver gain is 27 dBi (RALI FX21).

Free space loss calculations give a separation distance of about 1.5 km (free space loss is used as terrain effects would be negligible with a high antenna position).

### Multiple interferer, mobile receiver scenario

A scenario where multiple earth stations potentially cause interference to a TOB van was considered, using the parameters shown in Table 7.

Technical parameters for multiple interferer, mobile receiver scenario

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Notes |
| Earth stations antenna gain | 0 dBi | Table 6.1-1: IoT NTN reference scenario parameters |
| Bandwidth | 180 kHz |
| Earth station power | -7 dBW |
| Earth station height | 2 m |  |
| Duty cycle | 10 % | Arbitrary figure, logarithmically between 1% (metropolitan limit proposed in class licence variation) and 100% |
| Earth station deployment density | 2.4 / km2 | WP4C input 4C/327 |
| TOB receiver gain | 19 dBi | Report BT. 2069 Table 19 (Yagi) |
| TOB receiver height | 10 m | RALI FX21 |
| Interference threshold | -82.3 dBW (in 8 MHz) | RALI FX 21 |
| Propagation model | ITU-R P.526 | Propagation by diffraction |

Without area separation, the results show that coexistence is not possible, particularly for duty cycles higher than 1%.

Results for multiple interferer, mobile receiver scenario

|  |  |  |
| --- | --- | --- |
| Iterations where interference threshold met | | |
| Duty cycle | Menindee Lakes | Beaconsfield |
| 1% | 95% | 95% |
| 10% | 41% | 55% |

These results show that some separation is required.

Further analysis was conducted with the TOB receiver at varying distances from an area of dense earth station deployment. With small separations between the TOB receiver and the area containing the narrowband MSS earth stations, the interference criteria can be met:

results from the Menindee Lakes simulation indicate at least 2 km is required

results from the Beaconsfield simulation indicate 5 km is required.

### High gain receiver, multiple interferer scenario

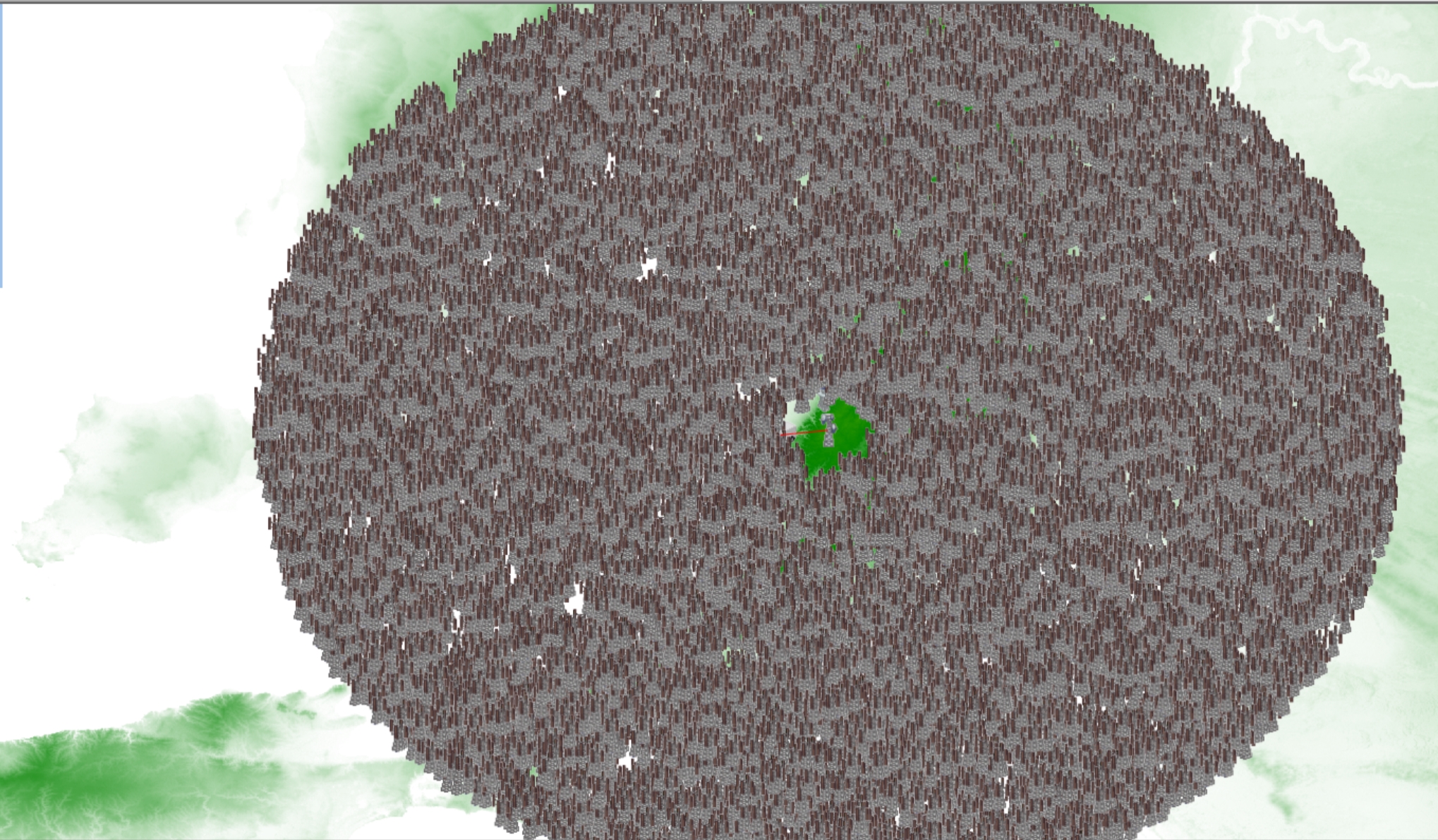
This scenario involved modelling aggregate interference power for a high gain receiver from a collection of earth stations at various distances. A metropolitan area with a high sited receiver was selected for modelling in order to illustrate worst-case separation distances to the receiver.

Technical parameters for multiple interferer, high gain receiver scenario

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Notes |
| Earth stations antenna gain | 0 dBi | 3GPP TR 36.763 Table 6.1-1: IoT NTN reference scenario parameters |
| Earth stations height | 2 m | Estimate, based on market research |
| Earth station power | -7 dBW | 3GPP TR 36.763 Table 6.1-1: IoT NTN reference scenario parameters |
| Earth station density | 2.4 per km2 | 4C input documents 4C/327 |
| Minimum separation | 10 km | Noting single entry values, a minimum earth station to TOB receiver of 10 km used |
| Bandwidth | 180 kHz | 3GPP TR 36.763 Table 6.1-1: IoT NTN reference scenario parameters |
| Duty cycle | 10 % | Arbitrary figure, logarithmically between 1% (CSO) and 100% |
| TOB receiver gain | 27 dBi | RALI FX21, modelled as omni-directional antenna |
| Site | -34.978867 138.708543 | Device ID 1667621644: Broadcast Australia Site Summit Road CRAFERS |
| TOB receiver height | 125 m | Licence information |
| Interference threshold | -82.3 dBW (in 8 MHz) | RALI FX 21 |
| Propagation model | ITU-R P.526 | Propagation by diffraction |

This scenario was simulated using a large number of earth stations located near a high gain TOB receiver serving Adelaide. The earth station density would lead to 108,573 stations within 120 km transmitting with a 10% duty cycle, however for this simulation, 10,857 stations were modelled at 100% duty cycle (due to software limitations). For each iteration of the simulation, each earth station was randomly located within 120 km of the high gain receiver. The interference contribution from each earth station was calculated, using the propagation model detailed in ITU-R Recommendation P.526. The interference contributions were summed, and a distribution of calculated interference as function of the number of iterations was produced. One thousand iterations were performed.

Setup of 10 857 stations around TOB receiver near Adelaide



Results of 10 857 station scenario, showing the interference threshold is exceeded (by approximately 6 dB)

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The results of this simulation reaffirmed the challenge for prominent sites (that is, a site placed to have visibility over a large area). For example, the free space loss component of the propagation loss with increased distance is offset by an increase in stations with increased distance (both are a function of distance squared). The dominant distance limiting factor is diffraction loss.

For high sited antenna sites, large distances (potentially of up to 120 km) may be required for significant diffraction losses.

Results show that at distances of many tens of kilometres, a deployment model of 2.4 stations per square kilometre results in a large number of stations and the interference threshold is exceeded.

### High gain receiver, multiple interferer scenarios (with a limit to concurrently transmitting stations)

The simulation was further refined to model a scenario with a limit of 1,334 concurrently transmitting stations. This number represents the total bandwidth of 5 MHz divided by the minimum 3GPP bandwidth of 3.75 kHz. A maximum distance of 120 km was used and a minimum distance of 10 km from the receive site. While the results of this simulation did not exceed the interference threshold level, when the power was increased by 3 dB (which is one way to simulate 2,668 stations), the results did exceed the interference threshold level for significant proportions (approximately 30%) of simulation steps.

It is not practicable to craft regulatory arrangements to directly prevent more than 1,334 concurrent transmissions (considering there may be multiple operators and satellite systems).

Using a maximum station density of 2.4 stations per km2, when coupled with a 1% duty cycle (as is included in the proposed class licence updates in metropolitan areas), results in approximately 1,080 concurrent transmissions within a circle of radius 120 km. It is proposed to limit operation to duty cycles of 1% near high gain receivers. Fixed stations may be considered (on a case-by-case basis) within those distances.

### High gain receiver, multiple interferer scenarios (with an EIRP spectral density limit)

A scenario was modelled with devices near a high gain receiver that were limited to 0.5 dBW/MHz (for example -7 dBW in 180 kHz). In this scenario, 28 devices (representing the number of 180 kHz emissions expected within 5 MHz) were randomly placed between 10 and 15 km from the receiver. The results exceeded the interference threshold level.

When the simulation was changed to place the stations between 10 to 20 km from the receiver, the interference threshold was satisfied. This shows a sensitivity to the proximity of the receiver that needs to be managed.

A uniform deployment density of 2.4 stations per km2 provides an estimate of 2,261 stations (between 10 to 20 km from the receiver). A 1% duty cycle for metropolitan areas[[12]](#footnote-13) will manage this sensitivity to proximity.

### Moderate gain example

The scenario of a moderate gain[[13]](#footnote-14) TOB receive antenna (17 dBi) was modelled, again with 1,334 stations (representing the higher power spectral density). This also displayed a sensitivity to the number of concurrent transmissions within 20 km that needs to be managed. When this number of devices was located within 10 to 15 km, the interference threshold was exceeded; however, if located between 10 to 20 km then the interference threshold was satisfied.

## Summary of results

The results of the simulations show that:

Single-interferer separation distances required are quite small (approximately 0.5 km for mobile and 1.5 km for high gain receivers).

Multiple-interferer results show separation is required for mobile receivers (for example, on a van) of up to 5 km.

To limit interference to certain fixed TOB receivers, the number of narrowband MSS devices with line-of-sight to the receiver needs to be limited (which is proposed to be achieved, in part, through duty cycle requirements):

high gain receivers are susceptible to interference from large numbers of devices at very large distances (approximately 120 km for high gain sites).

moderate gain sites also require limits to concurrent transmissions at distances of up to approximately 20 km.

Prohibiting operation in 2009–2010 MHz is considered prudent. The frequency dependent rejection modelling showed a decrease in rejection (that is, requiring an increase in protection ratio) above 2009 MHz. Recommendation ITU-R BT.1368-13 showed an increase in protection ratio 2009.5 MHz.

## Licence assessment procedures

Licensing of space/space receive licences (and the CSO Class Licence) may be granted in certain scenarios. Limits are listed in the CSO Class Licence and complemented by more detailed requirements in the BOP.

The CSO class licence requirements are reproduced[[14]](#footnote-15) below for convenience:

Stations are not permitted on aircraft.

An EIRP spectral density limit of -66 dBW/MHz applies at the band edge (2010 MHz).

In metropolitan areas:

a duty cycle limit of 1% applies

transmissions must not exceed 4 seconds

an EIRP spectral density limit of 0.5 dBW/MHz applies (note: this limits certain 3GPP power/bandwidth combinations).

Considering the above analysis, to ensure protection of adjacent band TOB services, the ACMA assessment procedure for issuing space and space receive licences will contain the additional requirements outlined below. All applications will need to provide supporting information demonstrating that they meet these and the requirements of the CSO Class Licence, including how the system will ensure unacceptable interference is not caused by large numbers of devices.

The requirements below are in additional to the ACMA current approach (as contained in the relevant [business operating procedure](https://www.acma.gov.au/sites/default/files/2021-04/BOP%20space%20and%20space%20receive_0.pdf)) of ensuring that the international processes are being undertaken and ensuring consistency with the Australian spectrum management regulatory environment. The requirements will be included as an appendix to the existing procedures.

**General requirement applicable to all applications**

The frequency band 2009–2010 is not available for space receive licensing (to be included in [Embargo 23](https://www.acma.gov.au/publications/2019-10/rules/embargo-23)).

The uplink band is to be populated from the lower frequency limit (that is, 2005 MHz) first, where practicable.

The EIRP of transmitting earth stations must not exceed -7 dBW.

Transmitting earth stations must employ bandwidths of at least 3.75 kHz.

Earth stations may not transmit within 10 km of listed TOB sites (both high gain and moderate gain sites, listed below).

Self-coordination is required between MSS operators having or seeking licences in Australia (for example by frequency domain sharing). This is in addition to any requirements resulting from the international satellite coordination processes through the ITU.

To support multiple operators within the band, operators are encouraged to licence only what they need (and no more than 1 MHz per operator). Alternative sharing methods (other than frequency sharing) may be considered. Applications should include an explanation of the sharing methodology and approach proposed.

Operation of MSS in metropolitan and designated areas is not to commence before 1 March 2026.

Operation of MSS will be subject to conditions of not causing interference to, and not claiming protection from, TOB stations licensed in accordance with the Radiocommunications (Mobile-Satellite Service) (1980–2010 MHz and 2170–2200 MHz) Frequency Band Plan 2022.

**Metropolitan areas**

For metropolitan areas, there are no additional requirement beyond the CSO Class Licence and general requirements outlined above.

**Outside metropolitan areas**

For EIRP spectral density of 0.5 dBW/MHz (that is, devices that would meet the metropolitan limit), the duty cycle limit is relaxed to 10%.

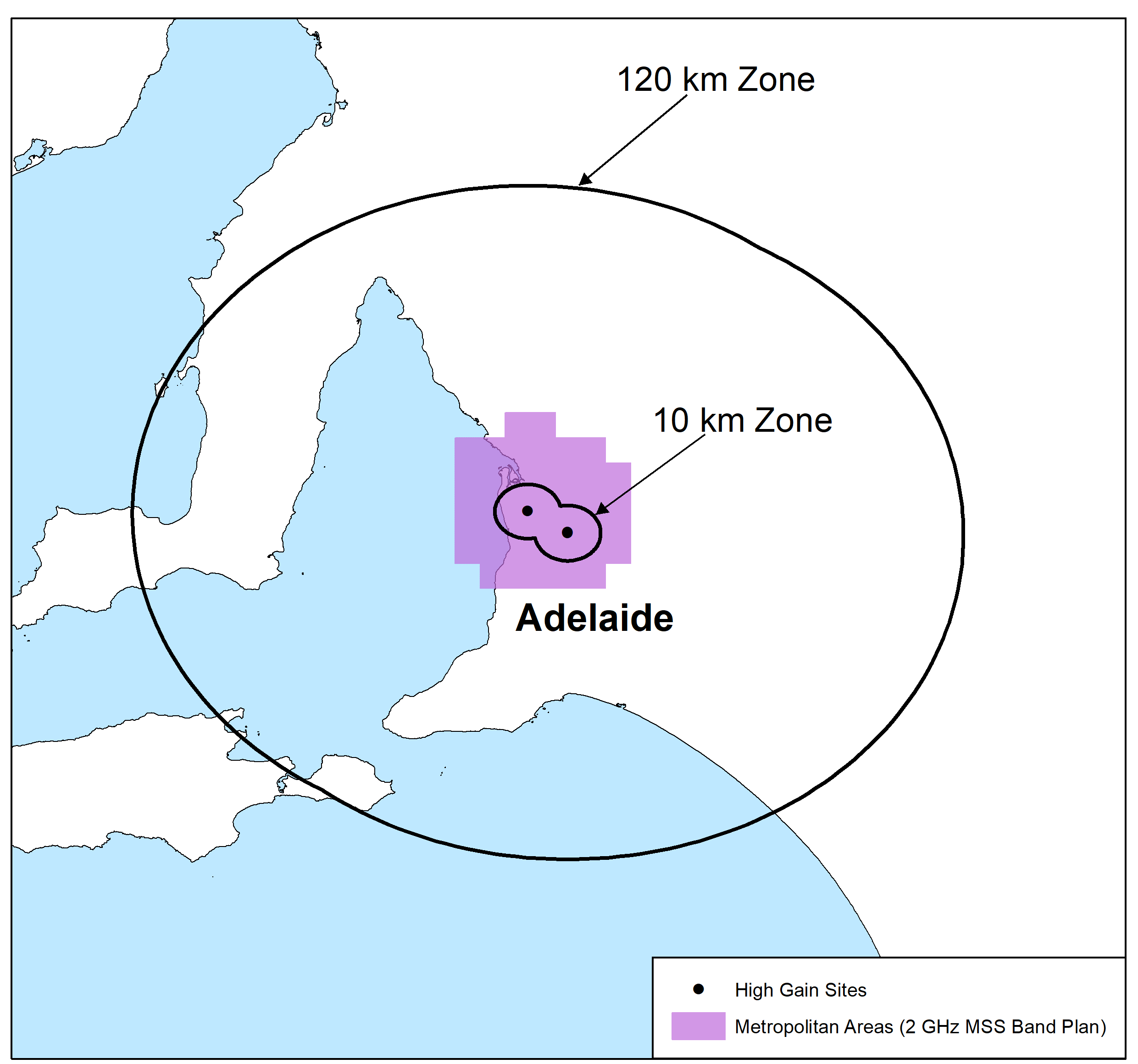
For EIRP spectral densities greater than 0.5 dBW/MHz (and less than 18.3 dBW/MHz):

for areas within 120 km of a high gain TOB (listed below) or within 20 km of a moderate gain TOB site (listed below), the duty cycle may not exceed 1%

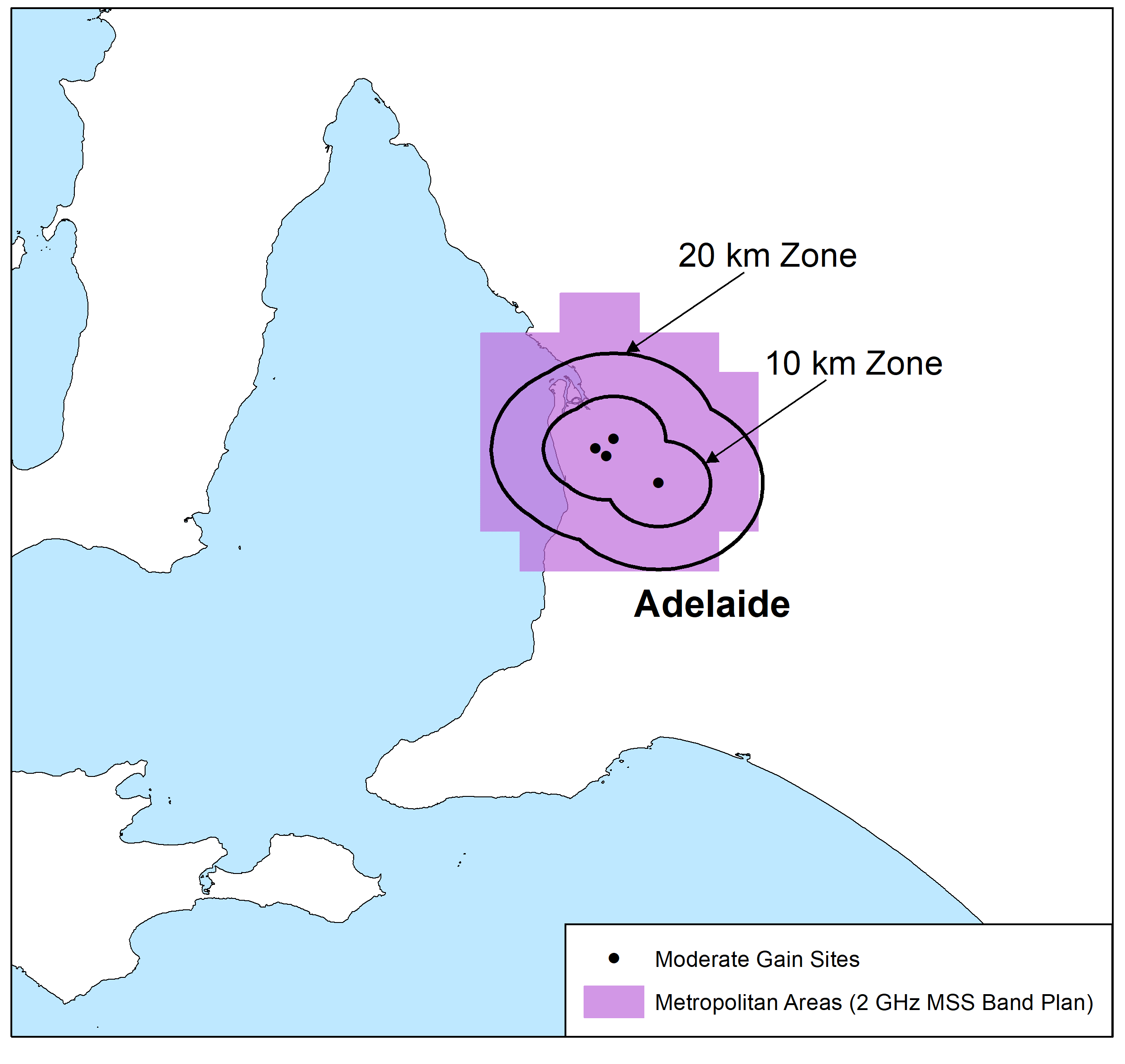
for other areas, the duty cycle is limited to 10%.

For example, Figure 7 shows the Adelaide area, depicting the location of the high gain TOB sites, the associated 10 km exclusion zone and the 120 km zone with potentially limited duty cycle. Figure 8 also shows Adelaide, with the moderate gain sites, the associate 10 km exclusion zone and the 20 km zone with potentially limited duty cycle. Metropolitan areas are also shown. The ACMA will make available an Australia-wide .kmz file for informative purposes.

Example of zones around Adelaide for high gain sites

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Example of zones around Adelaide for moderate gain sites



## List of high gain[[15]](#footnote-16) TOB sites

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| State | Latitude | Longitude | Site name | Site ID |
| NSW | -33.820079 | 151.185 | ABC Tower 221 Pacific Highway GORE HILL | 48711 |
| NSW | -33.861548 | 150.854947 | Axicom 102.7m Lattice Tower 77-89 Border Rd HORSLEY PARK | 201854 |
| NSW | -33.805516 | 151.18076 | TXA Artarmon Site Tower 192-196 Hampden Road ARTARMON | 4045 |
| NSW | -33.811691 | 151.195969 | TXA Willoughby Site Tower 15 Richmond Avenue WILLOUGHBY | 4129 |
| QLD | -27.466378 | 152.943371 | TXA B-Site Tower 560 Sir Samuel Griffith Drive MOUNT COOT-THA | 12757 |
| SA | -34.908683 | 138.576069 | Channel 7 Adelaide 40 Port Road HINDMARSH | 9004134 |
| SA | -34.982397 | 138.708346 | TXA NWS Site Tower 109 Summit Road CRAFERS | 23132 |
| SA | -34.98104 | 138.708078 | TXA Crafers Site Tower 115 Mount Lofty Summit Road CRAFERS | 23181 |
| SA | -34.978867 | 138.708543 | Broadcast Australia Site Summit Road CRAFERS | 23139 |
| VIC | -37.810323 | 144.967818 | 150 Lonsdale Street MELBOURNE | 38812 |
| VIC | -37.835419 | 145.347735 | TXA Eyre Road Site Tower 8 Eyre Road MT DANDENONG | 12015 |
| VIC | -37.81852 | 144.957141 | Rialto Towers 525 Collins Street MELBOURNE | 11599 |
| VIC | -37.813822 | 144.969482 | 120 Collins Street MELBOURNE | 11596 |
| VIC | -37.834892 | 145.348713 | BAI Comms Site 116-118 Ridge Rd MOUNT DANDENONG | 12014 |
| VIC | -37.881244 | 144.999296 | ABC-TV Studios 8 Gordon Street ELSTERNWICK | 34582 |
| VIC | -37.837476 | 145.34661 | TXA Ornata Road Site Tower 12 Ornata Road MOUNT DANDENONG | 12013 |
| VIC | -37.828469 | 145.353401 | TXA Observatory Road Site Tower 20-24 Observatory Road MT DANDENONG | 12010 |
| VIC | -37.886475 | 144.269148 | Police & Ambulance Site MT ANAKIE | 11694 |
| WA | -31.88197 | 115.857527 | Channel Seven Perth Off Dianella Dr Dianella | 142069 |
| WA | -31.884531 | 115.859305 | Channel 9 TV Studios Hayes Avenue DIANELLA | 26523 |
| WA | -31.954606 | 115.857086 | Bank West Tower 108 St Georges Terrace PERTH | 25931 |
| WA | -32.012667 | 116.061768 | TXA Carmel Site 255 Welshpool Road East CARMEL | 26624 |
| WA | -32.008347 | 116.084151 | Tower TXA Bickley Site Television Road BICKLEY | 26647 |
| WA | -31.878311 | 115.859826 | New10 Cottonwood Cres DIANELLA | 34599 |

## List of moderate gain[[16]](#footnote-17) TOB sites

| State | Latitude | Longitude | Site name | Site ID |
| --- | --- | --- | --- | --- |
| ACT | -35.270042 | 149.158275 | Ainslie Lookout MT AINSLIE | 9602 |
| ACT | -35.275515 | 149.097771 | Telecom Tower BLACK MOUNTAIN | 9580 |
| NSW | -33.805516 | 151.18076 | TXA Artarmon Site Tower 192-196 Hampden Road ARTARMON | 4045 |
| NSW | -33.868697 | 151.209364 | MLC Centre 19-29 Martin Place SYDNEY | 3351 |
| NSW | -33.870388 | 151.20912 | Centre Point Tower 112 Market St SYDNEY | 9002613 |
| NSW | -33.811691 | 151.195969 | TXA Willoughby Site Tower 15 Richmond Avenue WILLOUGHBY | 4129 |
| NSW | -33.867456 | 151.21085 | Colonial Centre 52 Martin Place SYDNEY | 3253 |
| NSW | -33.896668 | 151.19389 | Seven Network Studios 8 Central Avenue EVELEIGH | 138664 |
| NSW | -33.870174 | 151.190145 | Building C 19-33 Saunders St PYRMONT | 203119 |
| NSW | -34.147242 | 150.67077 | Wollondilly Council RFS site Lot 3 Mount Hercules Rd RAZORBACK RANGE | 34904 |
| NSW | -33.891238 | 151.250068 | Optus site Tower 2 Westfield Plaza 500 Oxford Street BONDI JUNCTION | 34680 |
| NSW | -33.934298 | 151.157471 | Airport Hilton Marsh Street ARNCLIFFE | 5290 |
| NSW | -33.931287 | 151.185445 | Cnr Oriordan & Robey Sts MASCOT | 3650 |
| NSW | -33.849872 | 151.057816 | RFS Site 15 Carter St HOMEBUSH | 404460 |
| NSW | -32.890196 | 151.538894 | NBN TV Site Mt Sugarloaf 3A Mount Sugarloaf Rd WEST WALLSEND | 5838 |
| NSW | -33.546826 | 150.616561 | Miles Comms Site 2 246 Burralow Road KURRAJONG HEIGHTS | 10143 |
| NT | -12.46358 | 130.840345 | Mitchell Centre 55 Mitchell Street DARWIN | 480820 |
| NT | -12.464178 | 130.844383 | ABC Studios 16-18 Bennett Street DARWIN | 34588 |
| NT | -12.448771 | 130.837229 | Lot 3119 Blake Street DARWIN | 1228 |
| NT | -12.414473 | 130.969253 | Broadcast Australia Site 100 Deloraine Rd SHOAL BAY | 139711 |
| NT | -12.458896 | 130.836978 | Marrakai Building Lot 5440 (93) Smith Street DARWIN | 1055 |
| QLD | -27.464574 | 152.94742 | BAI Comms Site 620 Sir Samuel Griffith Drive MOUNT COOT-THA | 12752 |
| QLD | -27.46313 | 152.94813 | TXA T-Site Tower 445 Sir Samuel Griffith Drive MOUNT COOT-THA | 12749 |
| QLD | -27.471614 | 152.942255 | TXA Q-Site Tower 632 Sir Samuel Griffith Drive MOUNT COOT-THA | 12761 |
| QLD | -27.472527 | 153.025353 | 111 George St BRISBANE | 52966 |
| QLD | -27.483962 | 153.036288 | Telstra Exchange 820 Main St WOOLLOONGABBA | 12930 |
| QLD | -26.657085 | 153.091886 | 140-142 Horton Pde MAROOCHYDORE | 16209 |
| QLD | -27.969604 | 153.213366 | GCT Mt Tamborine Site 103m Tower Golf Course Road MOUNT TAMBORINE | 403573 |
| QLD | -26.789909 | 152.918196 | Regional broadcaster tower Cnr Bald Knob Road and Landsborough-Maleny Road BALD KNOB | 15894 |
| QLD | -28.1384 | 153.481 | GCT Currumbin Site Monopole 66 Crest Drive CURRUMBIN | 40379 |
| QLD | -28.234736 | 153.28894 | 40m tower NRN Broadcast Site Bilbrough Lookout SPRINGBROOK | 153528 |
| QLD | -27.991715 | 153.428753 | Golden Gate Bldg Rooftop 3422 Gold Coast Hwy SURFERS PARADISE | 13795 |
| QLD | -26.683062 | 153.136393 | Breakwater Apartment Bldg 8 Pacific Bvd Pt Cartwright BUDDINA | 400580 |
| QLD | -27.7883 | 153.213012 | Crown Castle Site off Cliff Barons Road DARLINGTON RANGE | 13476 |
| QLD | -28.002222 | 153.426385 | QTQ 9 Offices 50 Cavill Avenue SURFERS PARADISE | 9022281 |
| SA | -34.888076 | 138.613894 | ABC Building 85 North East Road COLLINSWOOD | 22777 |
| SA | -34.924828 | 138.598754 | 91 King William Street Currie Street Frontage Santos House ADELAIDE | 22170 |
| SA | -34.908683 | 138.576069 | Channel 7 Adelaide 40 Port Road HINDMARSH | 9004134 |
| SA | -34.98104 | 138.708078 | TXA Crafers Site Tower 115 Mount Lofty Summit Road CRAFERS | 23181 |
| TAS | -42.878083 | 147.332304 | ABC Studios Brooker Avenue HOBART | 32730 |
| TAS | -42.897566 | 147.236358 | Broadcast Australia Site Pinnacle Rd MT WELLINGTON | 32830 |
| VIC | -37.810323 | 144.967818 | 150 Lonsdale Street MELBOURNE | 38812 |
| VIC | -37.815342 | 144.945415 | HSV-7 Bldg Colonial Stadium cnr La Trobe St Extn & Harbour Espl DOCKLANDS | 102197 |
| VIC | -37.837476 | 145.34661 | TXA Ornata Road Site Tower 12 Ornata Road MOUNT DANDENONG | 12013 |
| VIC | -37.835419 | 145.347735 | TXA Eyre Road Site Tower 8 Eyre Road MT DANDENONG | 12015 |
| VIC | -37.828469 | 145.353401 | TXA Observatory Road Site Tower 20-24 Observatory Road MT DANDENONG | 12010 |
| VIC | -37.81852 | 144.957141 | Rialto Towers 525 Collins Street MELBOURNE | 11599 |
| VIC | -37.814922 | 144.970588 | Broadcast/Comms Tower Roof 101 Collins Street MELBOURNE | 11597 |
| VIC | -37.813822 | 144.969482 | 120 Collins Street MELBOURNE | 11596 |
| VIC | -37.886475 | 144.269148 | Police & Ambulance Site MT ANAKIE | 11694 |
| VIC | -38.173546 | 144.300291 | Broadcast Site Brownhill Heights Reserve CERES | 8000005 |
| VIC | -38.354268 | 144.952035 | Air Services Australia Site Steane Ave ARTHURS SEAT | 9000919 |
| VIC | -37.813625 | 144.936307 | 476 Docklands Dr DOCKLANDS | 139648 |
| WA | -31.953914 | 115.855585 | Central Park Tower 170 Georges Terrace Perth | 142068 |
| WA | -32.012667 | 116.061768 | TXA Carmel Site 255 Welshpool Road East CARMEL | 26624 |
| WA | -31.88197 | 115.857527 | Channel Seven Perth Off Dianella Dr Dianella | 142069 |
| WA | -32.057926 | 115.751211 | Fremantle Hospital Lot 1970 Alma Street FREMANTLE | 27170 |
| WA | -31.952081 | 115.846971 | State Parliament House Harvest Terrace Perth | 142074 |

# Appendix B: Response to Communications Alliance SSWG

In 2020, the ACMA conducted a technical study and produced a paper on the coexistence between ubiquitous FSS and other services in the 28 GHz band, which informed the proposed changes to the CSO Class Licence

In December 2020, the draft technical paper was provided to the 26 GHz Technical Liaison Group (TLG) members, satellite industry members and operators of services in the 28 GHz band. Feedback was received from industry members, including from Communication Alliance’s (CA) Satellite Service Working Group (SSWG).

Below is the ACMA response to the CA SSWG submission that provides further reasoning for the decisions made.

## Technical paper

The technical paper was developed to provide a basis for ubiquitous FSS arrangements in the 27.5-28.3 GHz band. These arrangements were intended as additional to those already in place to support ubiquitous FSS in the rest of 28.3-30 GHz frequency range. We shared this paper with members of the 28 GHz Technical Liaison Group (TLG), existing 28 GHz fixed point to point licensees and prospective AWL licensees to provide feedback. The intention being that this feedback would be used to assist with refining our studies before any public consultation occurs.

As a result of the informal feedback we have received from CA SSWG members, we have revisited the adjacent area/adjacent band arrangements to explore the possibility of reducing the guard area and/or guard band.

However, we remain of the view that coexistence is not possible between ubiquitous, uncoordinated FSS earth stations in the populated areas and primary, protected FWA. Accordingly, we do not intend to further pursue this scenario.

## Other issues raised in the CA SSWG response

The CA SSWG’s response raised a number of points for our consideration. We have summarised these into four main areas:

1. Burden sharing: Fixed Satellite Services (FSS) and Fixed services are co-primary and should share the burden of managing interference

RALI MS 46: The criteria in RALI MS46 should be used when developing arrangements for ubiquitous FSS

Study parameters and methodology: Proposals related to performing statistical studies as well as study parameters and assumptions

Proposed arrangements for ubiquitous FSS: Alternative measures proposed to support the introduction of ubiquitous FSS

## Burden sharing

The CA SSWG response highlighted the primary status of both FSS and Fixed Services in the Australian Radiofrequency Spectrum Plan (the Spectrum Plan). Based on this it was proposed that both services should share the burden of interference mitigation.

The Spectrum Plan is a high-level planning document indicating what services are allocated in the band. A primary allocation in the Spectrum Plan does not mandate that these services be supported through domestic licensing, how these services may be licensed, nor dictate how interference should be managed with other services or applications within Australia. Part 4 of Chapter 1 of the Spectrum Plan outlines other aspects of the spectrum management environment in Australia.

The planning arrangements for the 28 GHz band were determined after an extensive public consultation process and have been published in the Outcomes Paper. Key outcomes that are applicable to this discussion are:

FWA services in the 28 GHz band (which have a primary allocation) are not afforded protection from apparatus or class licensed FSS use Australia-wide, except within the frequency range 27.5–28.1 GHz inside defined populations centres (yellow area in Figure 1). There is no burden sharing in this case. While affected parties can try negotiating to resolve any interference, if it occurs, FSS operators are under no obligation to modify operation to resolve it.

FWA services within the frequency range 27.5–28.1 GHz inside defined populations centres (yellow area in Figure 1), are coordinated with apparatus licensed FSS use on a first in time basis as detailed in RALI MS46.

Ubiquitous FSS use of the 28 GHz band is on a ‘no interference’ basis to FWA services operating within the frequency range 27.5–28.1 GHz inside defined populations centres (yellow area in Figure 1) subject to further analysis. If allowed there is no burden sharing in this case. While affected parties can try negotiating to resolve interference, if it occurs, it is the responsibility of ubiquitous FSS operators to modify or cease operation to resolve it.

Summary of planning arrangements for FWA and FSS in the 28 GHz band

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\* The possibility of this, including any restrictions on use, will be further investigated

The ACMA made planning decisions that make FWA services secondary to FSS in much of the band. In other parts of the band apparatus licensed FSS and FWA effectively operate on a co-primary basis. However, ubiquitous FSS (operating, if allowed, under a class licence) are effectively secondary to FWA services in the frequency range 27.5–28.1 GHz inside defined populations centres.

## RALI MS 46

The CA SSWG response suggested that the ACMA coexistence study is inconsistent with RALI MS 46 and should only use the -91.5 dBW/m2/MHz at a boundary identified in RALI MS 46.

While RALI MS 46 provides guidance on a number of criteria for the licensing of an AWL, it is important to note the coordination requirements for AWLs, which require that:

All AWLs must meet a PFD limit at the AWL boundary of -91.5 dBm/m2/MHz at height of 5m, ie UE coordination

Unsynchronised services must also coordinate with any existing licensed/registered receivers, ie FWA base station coordination, (both co-channel and adjacent channel) on a first-in-time basis

As FSS cannot synchronise with FWA, all FSS must coordinate with any existing licensed/registered receivers. For apparatus licence to apparatus licence coordination this will be undertaken on a first in time basis.

However, for class licence to apparatus licence coordination, given the ubiquitous nature (i.e., anywhere at any time) of class licensed devices, for the purposes of planning the ACMA must assume every apparatus licensed service has a registered receiver. Therefore, for the class licence to apparatus licence coordination both the UE and base station scenario were analysed. As demonstrated in the discussion paper, the base station scenario has the higher likelihood of receiving interference, hence it was the criteria used when determining coexistence criteria.

We also note, first-in-time coordination creates some mix of guard bands and/or areas between services. These are individually determined following a case-by-case analysis. Given the operation under a class licence does not allow for or require a case-by-case analysis, the ACMA needs to consider what guard bands and/or guard areas are required, based on the above analysis. These are then implemented in the class licence to allow the use of ubiquitous FSS.

## Study parameters and methodology

The CA SSWG response has provided the ACMA with some alternate parameters for ubiquitous FSS in the band (ie FSS power, FSS antenna gain), which are useful for a review of our analysis.

While the parameters for the FWA services used by the ACMA for the technical study were established and agreed at the 26 GHz TLG, we acknowledge that the 33 dBi antenna gain (derived from a 16 x 16 array antenna) should take into account uncorrelated effects and that 29 dBi can be used in the analysis.

We note the CA SSWG suggestion that an antenna height of 10 metres be used and that attenuation due to clutter be recognised. In discussion with companies that deploy systems at 28 GHz, the ACMA was advised that antennas for point to multipoint systems were typically placed above the clutter to ensure line of sight with UEs and 30 m was considered a reasonable height. We would also like to note that at the 26 GHz TLG, nbn representatives proposed the group consider 50 m antenna heights for FWA services.

We acknowledge that a deterministic methodology as used can result in conservative conclusions (especially if they are combined with conservative input parameters). However, we remain of the view they can serve a useful initial role in understanding the broad interference environment.

We are open to further studies being undertaken using a statistical methodology (such as a Monte Carlo simulation). Specifically, we recognised that if VSAT input parameters were modified and constrained further (for example, strict EIRP limits within certain elevation angles above the horizon, defining a minimum elevation angle, low duty cycles and/or not exceeding a defined pfd limit within 10 m of the device etc) and using the ACMA defined FWA parameters, then a statistical analysis may be warranted and provide materially different conclusions to the coexistence question. While we welcome operators to undertake an analysis using statistical methods, currently we do not see merit in the ACMA undertaking studies to investigate this issue further.

## Proposed arrangements for ubiquitous FSS

The CA SSWG views on the proposed measures to manage ubiquitous FSS provided in the response to the ACMA can be summarised as follows:

Guard area – smaller or no guard area is required

Guard band – no guard band is required

Requirements for A-ESIM – the requirements proposed by the European Communications Committee (ECC) (ITU-R Resolution 169 (WRC-19) above 3 km criteria) should be used in Australia instead of all requirements under ITU-R Resolution 169 (WRC-19) (ie including criteria below 3 km) inside defined population centres

statistical methods should be performed as they will demonstrate coexistence of ubiquitous FSS and FWA is possible

In light of CA SSWG feedback, the ACMA has revaluated guard bands, guard areas and the requirement for A-ESIM.

The CA SSWG did not provide the ACMA with any additional information to change the view that coexistence of FWA and land based ubiquitous FSS is not possible.

## Next steps

After reviewing all responses to the technical paper, the ACMA has reviewed the technical study and proposals. The technical study has reassessed all analyses, including guard areas and guard bands, using the parameters for ubiquitous FSS suggested by CA SSWG. These are:

Maximum VSAT power = -5.8 dBW/MHz

Maximum antenna gain at 40 degrees elevation = -12 dBi

Maximum FWA antenna gain = 29 dBi

Consider using the ECC values for A-ESIM (ie ITU-R Res. 169 above 3 km)

The ACMA will undertake the required steps in amending the Communicating with Space Objects (CSO) Class Licence, including any associated legislative and/or planning documents, based on the results of the revised study concerning guard areas and guard bands. This would also include a public consultation on the proposed amendments to the CSO Class Licence.

1. Spectrum embargoes are policy statements by the ACMA outlining the circumstances where it is likely to refuse to issue an apparatus licence in parts of the spectrum. [↑](#footnote-ref-2)
2. For example, new information on earth station power, bandwidth, deployment densities or emission masks. [↑](#footnote-ref-3)
3. As stated in their submissions to our 2020 consultation on proposed options for replanning the 2 GHz band. [↑](#footnote-ref-4)
4. That is, the receive power at the satellite may be too low. [↑](#footnote-ref-5)
5. Submission and processing of applications for space and space receive apparatus licences. [↑](#footnote-ref-6)
6. In the frequency band 2170–2200 MHz, spectrum arrangements support mobile satellite (space-to-earth) band, that is, earth station receivers. [↑](#footnote-ref-7)
7. The technical limits proposed in our consultation paper were developed with regard to the 3GPP work on 2 GHz non-terrestrial networks (TR 36.763). [↑](#footnote-ref-8)
8. Metropolitan and designated areas and TOB transition timeframes are set out in the Radiocommunications (Mobile-Satellite Service) (1980–2010 MHz and 2170–2200 MHz) Frequency Band Plan 2022. [↑](#footnote-ref-9)
9. For example, new information on earth station power, bandwidth, deployment densities or emission masks. [↑](#footnote-ref-10)
10. Duty cycle was not considered in the single interferer studies, with the focus on worst-case interference studies. [↑](#footnote-ref-11)
11. TOB stations with gains above 24 dBi are considered high gain stations. [↑](#footnote-ref-12)
12. High gain sites are in metropolitan areas, with a minimum distance to the edge of a metropolitan area of 13 km (east of Mount Dandenong, Victoria). [↑](#footnote-ref-13)
13. TOB stations with gains between 14 and 24 dBi are considered moderate gain stations. [↑](#footnote-ref-14)
14. Information is reproduced here for information only. Refer to the current version of the class licence to confirm current restrictions. [↑](#footnote-ref-15)
15. TOB stations with gains higher than 24 dBi. [↑](#footnote-ref-16)
16. TOB stations with gains between 14 and 24 dBi. [↑](#footnote-ref-17)