Australian Government | acma

Australian Communications and Media Authority

Planning of the 3700–4200 MHz band

Discussion paper

AUGUST 2019

communicating | facilitating | regulating

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Executive summary

In Australia, the 3700–4200 MHz band is currently used by a mixture of services and applications including point-to-point links, coordinated fixed satellite service (FSS) earth stations, radiodetermination and various low power class licensed devices.

Internationally, there has been growing interest in investigating options to make all or part of the 3700–4200 MHz band available for use by wireless broadband (WBB) services including 5G. These investigations have all carefully considered legacy uses of the band, especially by the FSS for 'C-band' satellite services that offer a range of unique characteristics important to the satellite operators and users.

Several countries have allocated or are in the process of examining options for the use of all or part of the 3700–4200 MHz band for WBB services. Most, including European and Middle Eastern countries, are focussing on the 3400–3800 MHz frequency range for initial 5G deployments. However, Japan recently awarded spectrum in the 3600–4100 MHz band and United Kingdom announced arrangements for shared access in the 3800–4200 MHz band. Canada and the United States of America are also looking at options to make all or part of the band available for WBB. This includes options for shared access with incumbent services.

In Australia, these international developments have increased interest from several competing services, including incumbent and WBB services, for access to the band. In contrast, elements of the satellite community have clearly articulated their concerns about any possible changes that would impact C-band satellite services.

The ACMA is alert to the needs of existing FSS and point-to-point uses of the band, as well as the potential for both wide-area and site-based (for example, Fixed Wireless Access or FWA) wireless broadband.

In response to these international and domestic developments, the 3700–4200 MHz band has been moved to the initial investigation stage of the ACMA's work program for major band replanning activities, as outlined in the *Draft five-year spectrum outlook 2019–23* (draft FYSO). Considering the whole band will simultaneously maximise the opportunity for a balanced approach that takes appropriate account of all interests. It is intended that undertaking a review of the band and affirming or otherwise changing domestic planning arrangements will provide increased certainty for all parties.

This paper identifies current uses and interests in the band—domestically, as well as emerging international trends. It seeks evidence on a range of issues to better understand the future needs of incumbent and prospective new services in the band. The aim is to identify what, if any, changes to arrangements in the band should be considered to ensure its use maximises the overall public benefit into the future.

To aid discussion, a number of possible planning scenarios for the band are presented:

> Provide access to the entire band for new services on either an exclusive or shared basis.

> Provide access to one or more segments of the band for new services on either an exclusive or shared basis. Maintain existing arrangements for incumbent services in the rest of the band.
> Provide access to one segment of the band on an exclusive basis to new services. Provide access for new services to another segment of the band on a shared basis. Maintain existing arrangements for incumbent services in the rest of the band.
> Maintain existing arrangements.

While the ACMA has yet to form any views on preferred long-term arrangements, these scenarios provide a means for examination of the follow issues:

> What services/applications should be accommodated in the band?
> Which frequencies ranges should be made available for these services/applications?
> Which geographic areas should be made available for these services/applications?
> On what basis should access be provided? Should access be granted on an exclusive or shared basis, on a coordinated or uncoordinated basis?
> What licensing mechanisms are appropriate?

The paper also examines compatibility issues with adjacent band services, as well as the potential benefits of aligning arrangements in all or part of the 3700–4200 MHz band with the lower adjacent 3.6 GHz band.

It is important to note that while this paper includes substantial discussion on possible wireless broadband use of the band, this does not indicate a predisposition on behalf of the ACMA regarding possible changes to the band. Rather, it reflects the current international and national focus of WBB as one of a number of possible uses of the band. The ACMA therefore considers it important to gain as much information as possible on this potential use of the band as an addition to further information on existing supported uses.

Submissions in response to this discussion paper will help the ACMA assess whether there is a case for further consideration of arrangements in the 3700–4200 MHz band, including whether or not to progress the band to the preliminary replanning stage of the ACMA replanning process. If progressed, there will be an additional public consultation that will canvas detailed planning options for the band before any regulatory decisions are made.

Issues for comment

The ACMA invites comments on the issues set out in this discussion paper:

1. Are there any other international developments in the 3700–4200 MHz band that the ACMA should be aware of?

2. What are the future requirements of point-to-point links and FSS earth stations in the 3700–4200 MHz band? Does this differ by geographical area and/or segment of the band?

3. If licensed point-to-point links and FSS earth stations are affected by replanning activities in the 3700–4200 MHz band, what alternative deployment options could be considered?

4. In the event arrangements are made for new services in the 3700–4200 MHz band, do stakeholders have any comments on the ACMA's proposal to maintain the existing arrangements for Radiodetermination and LIPD devices, and the existing policy around TVRO systems?

5. What are the future requirements for WBB services in the 3700–4200 MHz band and what arrangements should be considered? Does this differ by geographical area and/or segment of the band?

6. What WBB deployment scenarios should be considered for the 3700–4200 MHz band? Should use be limited to one scenario or should more flexible arrangements be implemented?

7. What is the current and planned availability of fixed and mobile WBB equipment in the 3700–4200 MHz band?

8. Is there interest in the use of other new service types in the 3700–4200 MHz band?

9. What services/applications should be accommodated in the 3700–4200 MHz band?

10. Which frequencies ranges should be made available for these services/applications?

11. Which geographic areas should be made available for these services/applications?

12. On what basis should access be provided? Should access be granted on an exclusive or shared basis, on a coordinated or uncoordinated basis, et cetera?

13. What licensing mechanisms are appropriate (spectrum, apparatus or class licensing)?

14. If arrangements for WBB specifically are implemented in the 3700–4200 MHz band, are the proposed interference management techniques with services in the 3.6 GHz band suitable? Are any other techniques proposed? Are there any other compatibility issues with the 3.6 GHz band the ACMA should consider?

15. Should the ACMA consider extending existing apparatus and spectrum licence arrangements in the 3.6 GHz band into the 3700–3800 MHz band or another segment of the 3700–4200 MHz band?

16. Is there any additional information available that would assist the ACMA in assessing compatibly of potential new WBB services in the 3700–4200 MHz band with WAIC and radio altimeter systems in the 4200–4400 MHz band?

Introduction

Purpose

In Australia, the 3700–4200 MHz band is currently used by a mixture of services and applications, being point-to-point links, FSS earth stations, radiodetermination and various low power class licensed devices.

Internationally, there has been growing interest in investigating options to make all or part of the 3700–4200 MHz band available for use by WBB services. A number of countries have or are in the process of making spectrum in this band available for such use, with much of the focus currently on the 3700–3800 MHz segment.

Simultaneously, there remains varying degrees of interest in continuing use of the band for C-band FSS purposes, which offer some unique capabilities. Some of the interested countries are also investigating the possible use of new or increased sharing approaches. This includes in some cases Dynamic Spectrum Access (DSA), which can actively allow temporary access to spectrum through the use of spectrum monitoring or querying databases.

As a consequence of these international developments, in the *Five-year spectrum outlook 2018–22* (FYSO 2018–22)[1], the 3700–4200 MHz band was moved to the initial investigation stage. Submissions to the draft FYSO[2] indicated that there is interest domestically in the ACMA investigating possible arrangements for fixed and mobile WBB in the band. This included local area (i.e. site-based) deployments under apparatus licence arrangements, typically of interest to wireless internet service providers (WISPs), local governments, utility companies and miners, as well as wide-area deployments, often supported by spectrum licence arrangements, which are of primary interest to mobile network operators (MNOs) and NBN Co. Submissions also indicated there is interest for continued FSS use of the band.

The ACMA is now seeking evidence and views on the development of future arrangements in the 3700–4200 MHz band by incumbent and new services.

Scope

The scope is limited to discussion of use of the 3700–4200 MHz band, and appropriate relationships with adjacent bands.

The paper canvasses a range of issues related to a potential replanning of the 3700–4200 MHz band. Depending on the feedback received on this paper, the ACMA may consider that arrangements in the band warrant further consideration. If so, the ACMA will engage further with industry to consult fully on possible replanning options before any changes are made to planning and access arrangements in the band.

[1] FYSO 2018–2022.

[2] Draft FYSO.

Legislative and policy environment

Managing spectrum efficiently and effectively for the benefit of all Australians is a key legislative requirement and priority for the ACMA.[3] The ACMA draws on a range of legislative and administrative tools in executing these functions.

Guiding legislation

Section 9 of the *Australian Communications and Media Authority Act 2005* (ACMA Act) sets out the spectrum management functions of the ACMA, including to:

> manage the radiofrequency spectrum in accordance with the *Radiocommunications Act 1992* (the Act)

> advise and assist the radiocommunications community.

Consistent with the spectrum management functions set out in the ACMA Act, the object of the Act is to provide for management of the radiofrequency spectrum in order to (among other goals):

> maximise, by ensuring the efficient allocation and use of the spectrum, the overall public benefit derived from using the radiofrequency spectrum

> provide a responsive and flexible approach to meeting the needs of users of the spectrum

> encourage the use of efficient radiocommunication technologies so that a wide range of services of an adequate quality can be provided

> support the communications policy objectives of the Australian Government.

The planning options set out in this paper are consistent with these goals. Specifically, improving access and use of the 3700–4200 MHz band for new services aligns with a number of key policy objectives, including:

> promoting, sharing and enabling trading of spectrum

> enhancing delivery of fast broadband services

> promoting the efficient use of spectrum through optimising its use

> fostering competitive telecommunications markets by providing potential new delivery mechanisms for ultra-fast broadband.

Principles for spectrum management

The ACMA is also guided by the Principles for spectrum management (the Principles), which are:

1. allocate spectrum to the highest value use (HVU) or uses
2. enable and encourage spectrum to move to its HVU
3. use the least cost and least restrictive approach to achieving policy objectives
4. to the extent possible, promote both certainty and flexibility
5. balance the cost of interference and the benefits of greater spectrum utilisation.

[3] *ACMA corporate plan 2018–19*

Figure 1: Spectrum management decision framework

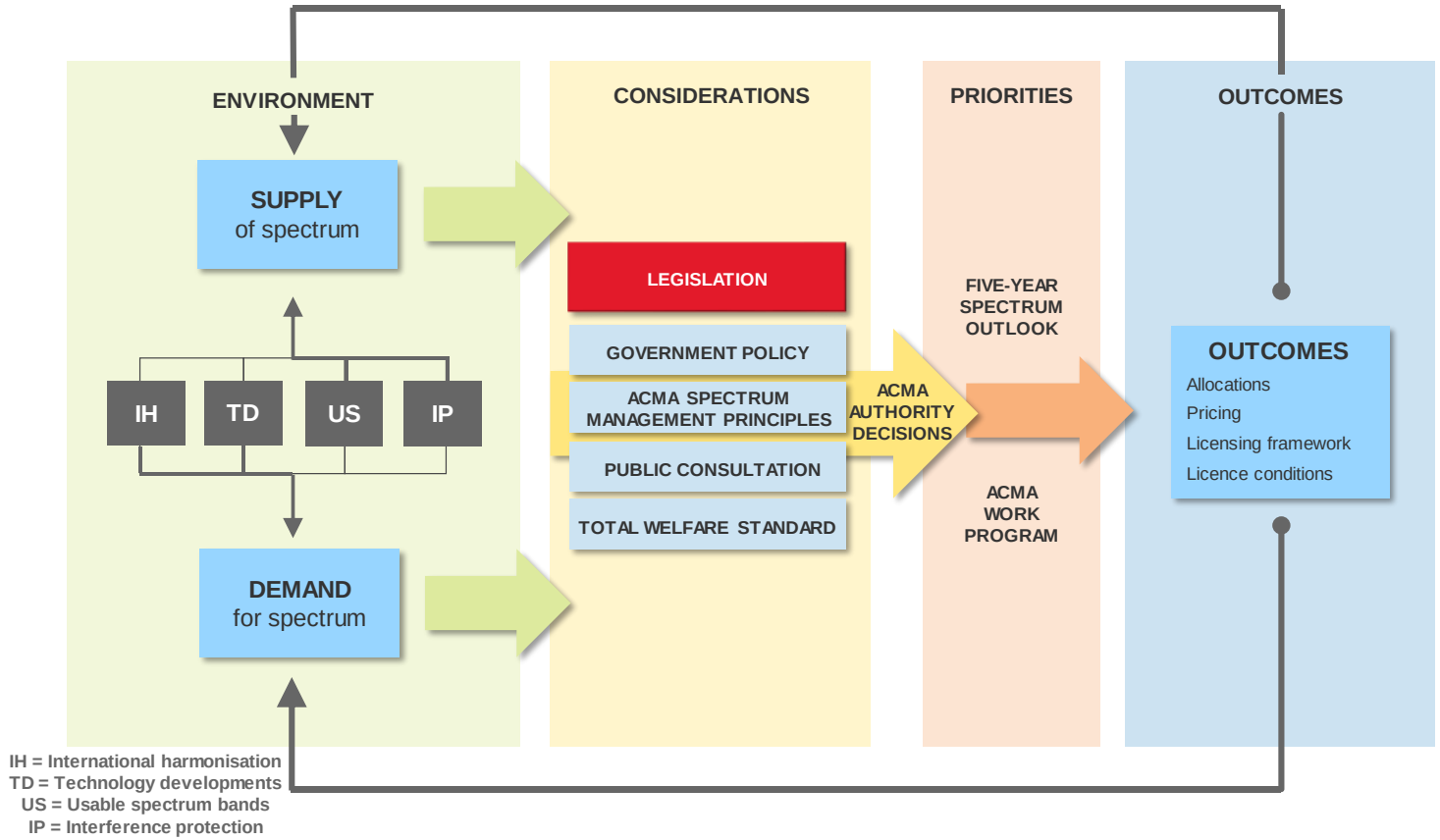

Figure 1 describes the ACMA's general approach to spectrum management decision-making.

Existing licensing regimes

There are three licence types available to authorise access to spectrum—spectrum, apparatus and class licences.

An apparatus licence authorises the use of a radiocommunications device (or group of devices) operating under a particular radiocommunications service type. Authorisation can be local area (i.e. site-based licence) or for a defined larger area (area-wide licence), across a particular frequency range for a period of up to five years. Local area (site-based) apparatus licences are typically issued on a first-in-time basis 'over-the-counter' in accordance with coordination rules developed by the ACMA. For an area-based apparatus licence, the licensee typically has sole or primary access to a defined frequency and area for the deployment of services. Services deployed under an area-based licence still need to coordinate with other services, though this is often limited to services in adjacent bands and areas.

A spectrum licence authorises the use of a particular frequency band within a particular geographic area for a period of up to 15 years. The geographic area can vary in size up to Australia-wide. Spectrum licences have historically been utilised to facilitate the rollout of wide-area wireless broadband networks.

An inherent feature of spectrum licensing is technological flexibility—that is, the licensing rules, while usually optimised for an expected technology, generally specify only generic technical details and limitations[4], while not expressly mandating a particular type of technology or service. This allows a licensee to deploy any technology as long as it complies with the terms and conditions of the licence, without intervention from the regulator. It is up to the licensee to manage interference between radiocommunications devices, although this can be mitigated by the adoption of international standards. Spectrum licences are also more conducive to spectrum trading than apparatus licences, due to their intended longer tenure, ability to be sub-divided and technological flexibility.

Class licences are a standing authorisation to use spectrum without the need to apply to the ACMA for access, so long as the conditions of the class licence are met. These conditions can be technical, geographic and/or pertain to the type of use or class of user.

Both class and local area apparatus licensing arrangements are in place to support existing uses of the 3700–4200 MHz band.

Next steps

Table 1 provides a notional timeline for the next steps of the review of arrangements in the 3700–4200 MHz band.

[4] Technical details and limitations include maximum in-band transmit power and unwanted emissions limits as well as the authorised frequency range and geographical area of the licence.

Table 1: Indicative timeline for 3700–4200 MHz band review process

Milestone	Date
Release: *Future use of the 3700–4200 MHz band* (initial investigation paper)	7 August 2019
Submissions due to options paper	13 September 2019
Release: *Future use of the 3700–4200 MHz band* (options paper)	Q1 2020
Release: *Future use of the 3700–4200 MHz band* (planning decisions and preliminary views)	Q2 2020
Pending planning decisions made (implementation of review outcomes)	Q2 2020 onwards

Current use and arrangements

Current planning arrangements and use

Historically, the 3700–4200 MHz band has been used by apparatus licensed FSS earth stations (space-to-Earth) (i.e. earth receive) and the fixed service (i.e. point-to-point links).

Figure 2 provides the current arrangements in the 3700–4200 MHz band (shown by the shaded area) and adjacent bands. Table 2 shows a summary of the current number of licences in the band.

Figure 2: 3700–4200 MHz band arrangements

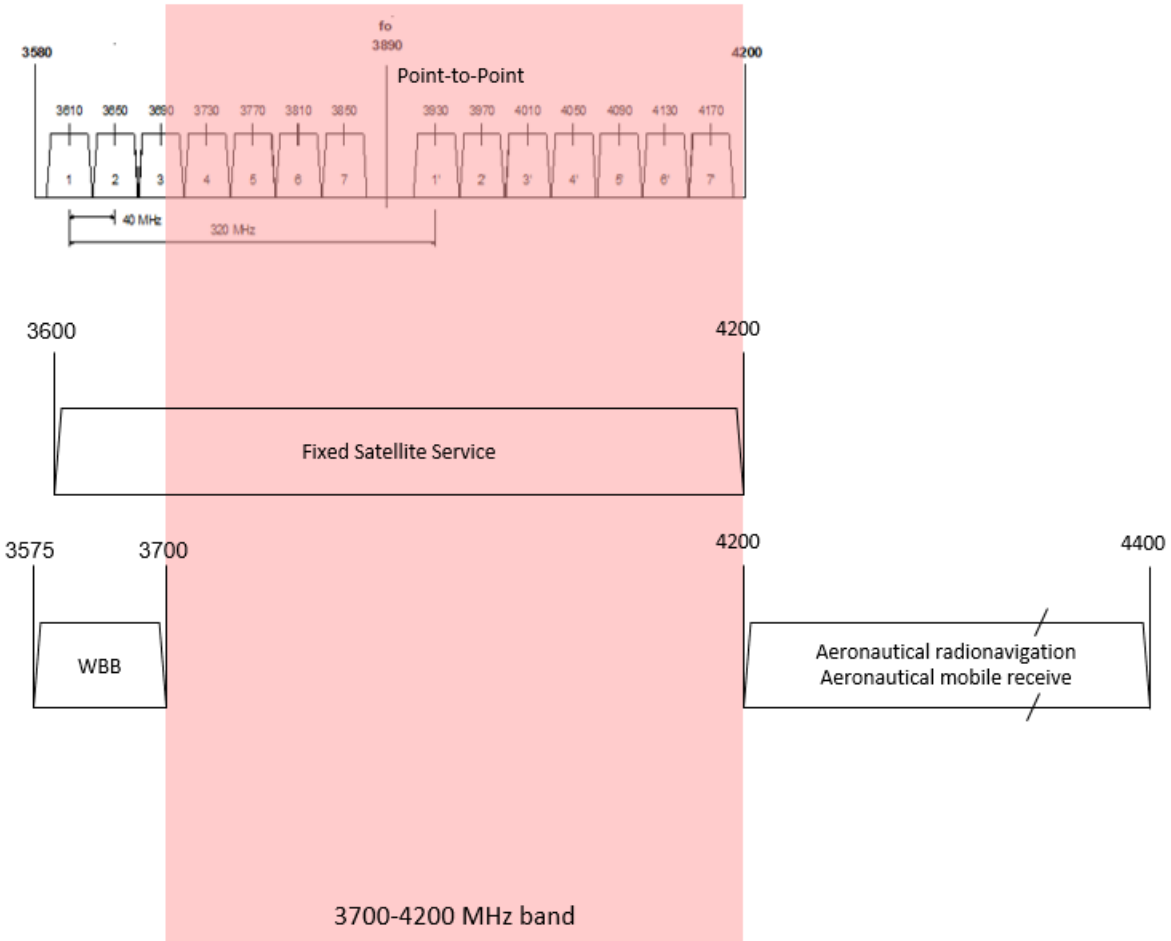

Table 2: Breakdown of licence numbers in the 3700–4200 MHz band (RRL extract, 1 May 2019)

Licence type	No. of licences (devices[5])	No. of licensees	Major licensees (number of devices)
Earth receive	255 (328) (58 discrete site locations)	25	Telstra Corporation Limited (83), Optus (54), Intelsat (42), Inmarsat (27), Foxtel (27), Preparatory Commission for the CTBTO[6] (26)
Point-to-point	103 (384)	4	Digital Distributions Australia (232), Telstra (130)
Radiodetermination	1 (3)	1	Department of Defence (3)

Fixed service (point-to-point links)

Frequency assignment instructions for point-to-point links operating in the 3700–4200 MHz band are defined in RALI FX3 *Microwave fixed services frequency coordination*. RALI FX3 restricts any new point-to-point link assignments being issued in the 3590–3710 MHz frequency range (this is also covered by Embargo 42). In 2017 as part of the ACMA's s review of arrangements in the adjacent 3575–3700 MHz (3.6 GHz) band, Embargo 73 was placed on the 3710–3790 MHz band in defined metropolitan and regional areas. This was done to limit the potential for spectrum denial caused by point-to-point links to adjacent 3.6 GHz band WBB deployments.

Use of the band by point-to-point links has steadily declined over the last 20 years, as Table 3 demonstrates.

Table 3: Point-to-point licences over time

Date	Point-to-point licenses (devices)
June 2000	1090 (4008)
June 2005	714 (2588)
June 2010	302 (1032)
June 2015	190 (616)
May 2019	103 (384)

[5] Individual transmitter or receiver devices, so that impact on devices can be assessed

[6] an international organization that is tasked with building up the verification regime of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), including a worldwide series of monitoring stations.

Fixed-satellite service (FSS)

In Australia, FSS earth stations are used for the reception of satellite transmissions in the broader 3400–4200 MHz band. Licensed FSS earth station are individually coordinated to protect them from interference.

Traditionally, a majority of FSS use has been in the 3700–4200 MHz band (also known as the standard C-band). Of note, due to their concentration of licences, are the services located in the Belrose/Oxford Falls area in Sydney, and Landsdale and Lockridge in Perth operated by Telstra and Optus. There are, however, a range of other users and geographic locations for FSS earth stations in the band.

Based on feedback received to previous consultation processes, the ACMA is aware that there are unlicensed FSS earth stations operating in Australia. This includes Television Receive Only (TVRO) systems operating in the 3400–4200 MHz band. These are typically used to obtain fortuitous reception of satellite television services licensed for operation in other countries. In response to previous consultations, satellite industry representatives have suggested there may be in the order of 200,000 TVRO systems operating in Australia. It is important to note that FSS earth stations are only afforded protection if they are licensed. The ACMA does not propose any change to this policy as part of the review of arrangements in the 3700–4200 MHz band.

The ACMA has identified several locations as prospective Earth Station Protection Zones (ESPZ) to provide long term options and certainty for FSS use of numerous satellite bands, including the 3700–4200 MHz band. An additional aim of these ESPZs is to promote, where practical, the siting of earth stations outside of major population centres. In this way satellite services can continue operating, while freeing up spectrum in populated areas for other uses.

Details of current ESPZs are contained in RALI MS44 *Frequency coordination procedures for the Earth Station Protection Zones*. While the ESPZ in western Australia has been long established, the ACMA is still investigating the viability of the ESPZ's in eastern Australia, with a view to identifying one or two of these as long term ESPZ's.

Use of the 3700–4200 MHz band by FSS earth stations steadily increased from the year 2000 until 2015, but has declined in recent years, as Table 4 demonstrates.

Table 4: Earth Receive licences over time

Date	Earth Receive licenses (devices)	Total licenced receiver bandwidth for devices (GHz)
June 2000	40 (67)	2.15[7]
June 2005	99 (136)	0.83
June 2010	279 (340)	2.20
June 2015	347 (433)	1.51
May 2019	255 (328)	0.92

[7] Note: In the year 2000 there were 14 devices that were licensed to receive over a combined bandwidth of 1.77 GHz. It is possible this was done to simplify licensing of multiple earth stations across the band and could consequently be distorting the total bandwidth licensed to earth receivers at the time.

Radiodetermination

Radiodetermination does not have any allocation based on the national spectrum plan, but three assignments are registered in the remote Northern Territory. These have been licensed under section 10(7) of the Australian Radiofrequency Spectrum Plan 2017.

Low interference potential devices

The Radiocommunications (Low Interference Potential Devices) Class Licence 2015 (the LIPD) defines arrangements for the following devices to operate across the 3700–4200 MHz band:

> building material analysis transmitters operating in the 2200–8500 MHz band

> ultra-wideband transmitters operating in the 3400–4800 MHz band.

Operation of devices under the LIPD is on a 'no interference and no protection' basis with other licensed services.

Embargoes

There are four embargoes currently in place that cover all or part of the 3700–4200 MHz band in specified areas:

> Embargo 41—covers the 70 MHz–25.25 GHz band. It was established to create a radio quiet zone (RQZ) near Boolardy Station in Western Australia to facilitate the development and use of new radio astronomy technologies. This RQZ is centred on the CSIRO Murchison Radio astronomy Observatory (MRO), built for the future Square Kilometre Array (SKA) and other radio astronomy projects.

> Embargo 42—covers the 3575–3710 MHz band. It was put in place in September 2005 while future planning options for the band were being considered under the ACMA's *Strategies for wireless access services* consultation process. Embargo 42 was revised in November 2016 to restrict access to the 3575–3710 MHz band for point-to-multipoint services in metropolitan and regional areas. Restrictions still apply Australia-wide to the issue of new licences for point-to-point links and FSS earth stations.

> Embargo 73—this embargo was developed to support wireless broadband use in 3575–3700 MHz by restricting new point-to-point licensing being issued in the band 3710–3790 MHz in metropolitan and regional areas of Australia, to minimise spectrum denial to adjacent band wireless broadband services. It was put in place in 2017.

Details of licences in the 3700–4200 MHz band

Figure 3 shows the location of existing licensed devices in the 3700–4200 MHz band as of 1 May 2019. Tables 5 and 6 show a breakdown of existing licensed devices by area and frequency range. Appendix 2 also provides an assessment of the spectral occupancy of apparatus licensed services by geographical area.

Figure 3: Location of embargoed areas and licensed devices in the 3700–4200 MHz band (RRL extract, 1 May 2019)

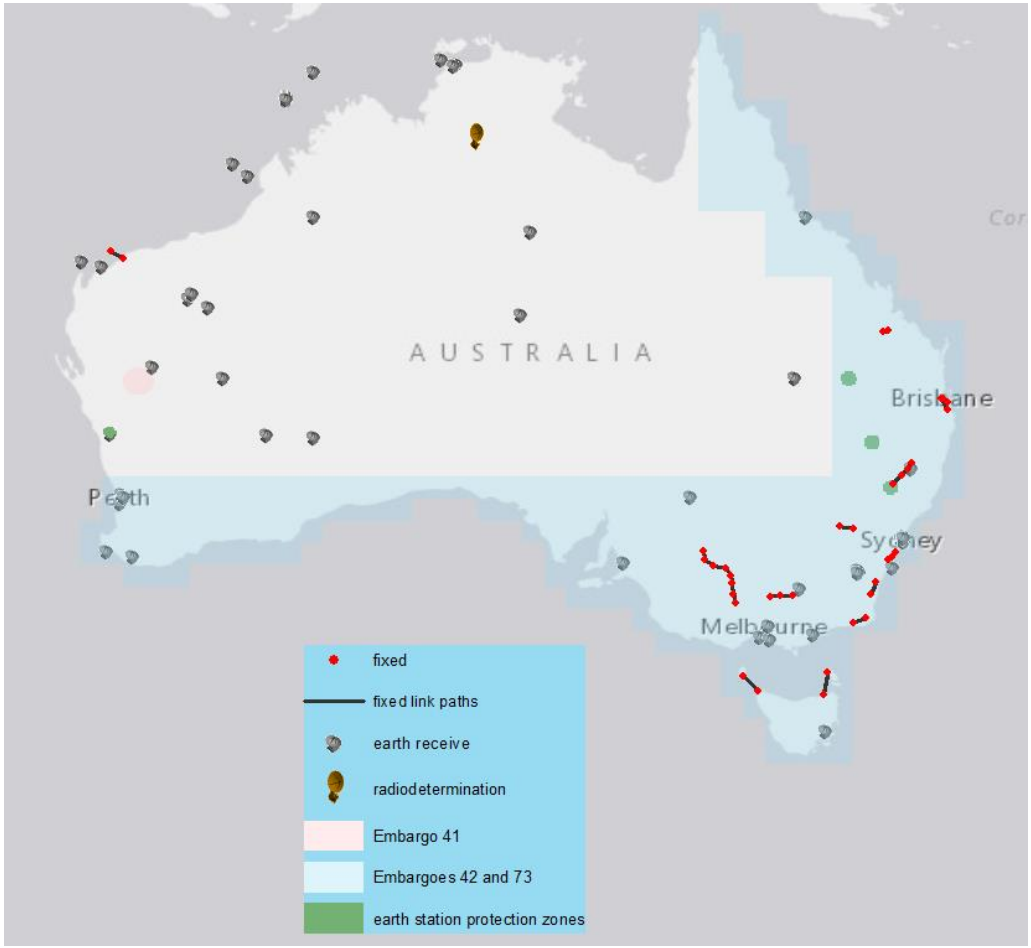

Table 5: Breakdown of point-to-point devices in the 3700–4200 MHz band by area and frequency range (RRL extract, 1 May 2019)

Area[9]		Number of devices by frequency range[8]					
		Entire 3700–4200 MHz	3700–3800 MHz	3800–3900 MHz	3900–4000 MHz	4000–4100 MHz	4100–4200 MHz
Metropolitan	Adelaide	0	0	0	0	0	0
	Brisbane	12	2	2	6	2	2
	Canberra	0	0	0	0	0	0
	Melbourne	0	0	0	0	0	0
	Perth	0	0	0	0	0	0
	Sydney	40	16	4	12	12	8
	Total	52	18	6	18	14	10
Regional	Regional	288	94	72	22	64	108
	Regional plus Metropolitan	340	112	78	40	78	118
Australia-wide	Remote (Australia-wide minus Regional minus Metropolitan)	44	18	10	0	12	14
	Australia-wide	384	130	88	40	90	132

[8] A device, either transmitter or receiver, is deemed to be within a defined frequency range if any part of its licensed bandwidth falls within the defined frequency range, hence one licensed device may appear in two ranges.

[9] Areas defined in Appendix 1.

Table 6: Breakdown of Earth Receive licensed devices and locations in the 3700–4200 MHz band by area and frequency range (RRL extract, 1 May 2019)

Area[12]		Number of devices (number of locations[10]) by frequency range[11]					
		Entire 3700–4200 MHz	3700–3800 MHz	3800–3900 MHz	3900–4000 MHz	4000–4100 MHz	4100–4200 MHz
Metropolitan	Adelaide	2 (1)	0 (0)	0 (0)	1 (1)	0 (0)	1 (1)
	Brisbane	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	Canberra	5 (3)	2 (2)	0 (0)	0 (0)	0 (0)	3 (2)
	Melbourne	5 (3)	1 (1)	1 (1)	0 (0)	0 (0)	3 (2)
	Perth	70 (5)	18 (3)	9 (1)	19 (3)	13 (2)	12 (2)
	Sydney	134 (5)	38 (5)	47 (7)	35 (4)	15 (4)	8 (2)
	Total	216 (20)	59 (11)	57 (9)	55 (8)	28 (6)	27 (9)
Regional	Regional	18 (9)	4 (3)	0 (0)	0 (0)	1 (1)	13 (6)
	Regional plus Metropolitan	234 (29)	63 (14)	57 (9)	55 (8)	29 (7)	40 (15)
Australia-wide	Remote (Australia-wide minus Regional minus Metropolitan)	94 (29)	13 (7)	9 (5)	32 (6)	4 (3)	35 (15)
	Australia-wide[13]	328 (58)	76 (21)	66 (14)	88 (14)	33 (10)	75 (30)

[10] Approximate discrete locations, for example one satellite park, teleport or gateway.

[11] A device, either transmitter or receiver, is deemed to be within a defined frequency range if any part of its licensed bandwidth falls within the defined frequency range, hence one licensed device may appear in two ranges.

[12] Areas defined in Appendix 1.

[13] Including offshore and external territories.

International developments

This section provides an overview of international arrangements and developments in the 3700–4200 MHz band, examining:

> arrangements and developments within international organisations

> country-specific arrangements and developments.

International organisations

International Telecommunications Union (ITU) Article 5 of the ITU Radio Regulations defines the current service allocations for the 3700–4200 MHz frequency range for all regions of the world (refer to Table 7)**Error! Reference source not found.**, which includes an extract from the Australian Table of Allocations).

Table 7: ITU-R and Australian Table of Allocations for the 3700–4200 MHz band

<table>
<tr><th colspan="3">ITU Radio Regulations Table of Allocations</th><th rowspan="2">Australian Table of Allocations</th></tr>
<tr><th>Region 1</th><th>Region 2</th><th>Region 3</th></tr>
<tr><td>3.6 - 4.2 GHz
FIXED
FIXED-SATELLITE (space-to-Earth)
Mobile</td><td colspan="2">3.7 - 4.2 GHz
FIXED
FIXED-SATELLITE (space-to-Earth)
MOBILE except aeronautical mobile</td><td>3.6 - 4.2 GHz
FIXED
FIXED-SATELLITE (space-to-Earth)
MOBILE except aeronautical mobile</td></tr>
</table>

Note that this band does not have a footnote in the Radio Regulations identifying its use for the implementation of International Mobile Telecommunications (IMT). Although not required to use a band for wireless broadband services, it can assist in global or regional harmonisation, including the development of economies of scale for equipment.

Third Generation Partnership Project (3GPP)

The 3700–4200 MHz band forms part of the profile bands for 4G and 5G internationally and has been included in standards developed by the 3GPP. This includes:

> 5G (referred to as New Radio by the 3GPP) bands n77 and n78[14], defined for TDD technologies with bandwidths between 10–100 MHz over the 3300–4200 MHz and 3300–3800 MHz bands respectively

> 4G (referred to as E-UTRA or LTE by the 3GPP) band 43[15], for TDD use in the band 3600–3800 MHz. Channel bandwidths up to 20 MHz are defined. The aggregation of multiple channels within the band (and with other bands) is also supported.

Global mobile Suppliers Association (GSA)

GSA's online database of mobile broadband devices (GAMBoD) reports that on 20 June 2019 there were 198 LTE devices (routers, femtocells, phones, tablets, outdoor customer premise equipment) that operate in the 3600–3800 MHz band. This suggests that a viable equipment ecosystem has already developed in the band.[16]

[14] 3GPP TS 31.104, *New radio: Base Station (BS) radio transmission and reception*, Release 15.

[15] 3GPP TS 36.104, *Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception*, Release 16.

[16] *Global TD-LTE Snapshot*, GSA, November 2018.

GSA has also reported that an ecosystem for 5G devices is starting to emerge. This includes devices supporting the 3300–3800 MHz or 3300–4200 MHz bands. In June 2019, thirty-nine vendors had announced available or forthcoming 5G devices and chipsets were available from four vendors.[17]

Country-specific developments

Europe

In January 2019 the European Commission (EC) announced[18] its decision to harmonise the 3400–3800 MHz frequency range as a pioneer band for 5G use within the European Union. Many European countries either have or are in the process of investigating or allocating the band for 5G use. Germany and Lithuania are also developing plans to make the 3700–3800 MHz band available for local area 5G use rather than wide-area deployments.[19]

Ofcom (United Kingdom) has announced their intention to award spectrum in the 3600–3800 MHz band. This is in addition to spectrum already allocated in the 3400–3600 MHz band.[20] On 25 July 2019, Ofcom also announced its decision to allow use of the 3800–4200 MHz band for WBB through a shared local licensing arrangement[21] on a first-in-time coordinated basis. Low power small area licences and medium power rural area base station licences will be available. Private network and fixed wireless access (FWA) are some of the potential uses Ofcom envisage through this arrangement. Ofcom also indicated that this is an interim approach to enable the quickest route for new users to access the band but flagged its intention to explore the potential for introducing Dynamic Spectrum Access (DSA) arrangements.

In June 2019, the Post and Telecom Authority in Sweden released a consultation of a preliminary study report[22] into the future use of the 3800–4200 MHz band, noting its current use by Defence for radio links and satellite reception, and by video Program Makers and Special Events (PMSE).

In July 2019, the Ministry of Communications in Israel released a tender[23] for 5G spectrum bands, including the 3600–3800 MHz frequency range.

Middle East

On 2 January 2019, Qatar's Ministry of Communications announced that it had granted licences for 5G networks in the 3500–3800 MHz band. Operators were granted 100 MHz of spectrum each.[19]

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[17] *5G Device Ecosystem*, GSA, June 2019.

[18] *EC 5G decision announcement*, 24 January 2019.

[19] *Spectrum for Terrestrial 5G Networks: Licensing Developments Worldwide*, GSA, 14 May 2019.

[20] https://www.ofcom.org.uk/__data/assets/pdf_file/0019/130726/Award-of-the-700-MHz-and-3.6-3.8-GHz-spectrum-bands.pdf, Ofcom 18 December 2018.

[21] enabling wireless innovation through local licensing

[22] https://pts.se/sv/dokument/remisser/radio/2019/samrad-av-forstudierapport-38--42-ghz-3800--4200-mhz/, PTS 12 June 2018.

[23] https://www.gov.il/BlobFolder/news/14072019_01/he/5th%20Gen%20Tender%20-%20English.pdf.

Saudi Arabia has issued trial licences for 5G services in the 3600–3800 MHz band. These are expected to be converted to full licences in 2019. In March 2019 Saudi Arabia announced it had allocated 400 MHz of spectrum in the 3.5 GHz band. [19,24]

The United Arab Emirates are considering the deployment of 5G in the 3300–3800 MHz band. 5G FWA trial licences have been issued in the band.[19]

Asia-Pacific

In February 2019, New Zealand announced the 3410–3800 MHz band would be allocated for 5G. The spectrum will be auctioned in 2020 and ready for use in November 2022.[25]

In April 2019, the Ministry of Internal Affairs and Communications (Japan) awarded spectrum in the 3600–4100 MHz band for 5G. Mobile operators must commence services within two years and must each meet defined coverage targets.[19]

Americas

In 2018, Innovation, Science and Economic Development Canada (ISED) launched a preliminary consultation on changes to the 3700–4200 MHz band to accommodate wireless broadband use.[26] The outcomes of the consultation were announced in June 2019. Submissions indicated that equipment for the 3300–3800 MHz band is expected to be available in 2019, while equipment for the 3300–4200 MHz band would likely be available in 2020. ISED also announced its decision to undertake further study and review of the 3700–4200 MHz band through a future consultation. This will consider the potential for implementing a spectrum access system or similar database approach in to order to optimise use.[27] Such a database would have the capacity to analyse interference situations and instruct base stations to reduce power or move to a different channel in order to minimise interference.

In 2018 the Federal Communications Commission (United States) consulted on transitioning all or part of the 3700–4200 MHz band for terrestrial wireless broadband use. This included exploring sharing options and market-based mechanisms to facilitate such use. Regarding incumbent services:

> The FCC proposed to protect FSS earth stations that were licensed before 17 October 2018 and limit new licences being issued beyond this date. Unlicensed FSS earth stations could continue operating in the band without protection. To help evaluate the potential for flexible use of the 3700–4200 MHz band the FCC have also requested further information on satellite usage of the band.[28]

> On 3 June 2019 the FCC invited additional comments on proposals for enabling additional terrestrial use of the 3700–4200 MHz band (C-band).[29]

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[24] *Saudi Arabia Announces MENA's Largest 5G Roll-Out*, media release, Ministry of Communications and Information Technology Saudi Arabia, 26 Feb 2019.

[25] *Preparing for 5G in New Zealand*, Radio Spectrum Management, New Zealand.

[26] *Consultation on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Consultation on Changes to the 3800 MHz Band*, ISED.https://gsacom.com/download.php?id=6824

[27] *Decision on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Decisions on Changes to the 3800 MHz Band*, ISED, June 2019.

[28] https://www.fcc.gov/document/fcc-expands-flexible-use-mid-band-spectrum.

[29] https://www.federalregister.gov/documents/2019/06/03/2019-11448/international-bureau-and-wireless-telecommunications-bureau-seek-focused-additional-comment-in-37-42.

- Due to the decline in fixed link use of the band over the past 20 years as well as the availability of other spectrum options, the FCC proposed to sunset fixed link arrangements in the 3700–4200 MHz band. The FCC sought further comment on whether existing links should be grandfathered or transitioned out of the band over a defined period.
- Satellite Industry group the C-band Alliance proposed the 3700–3900 MHz band to be used for 5G services and to be compensated for clearing that spectrum.[30]
- Communications industry group "ACA Connects" proposed 370 MHz of the 3700–4200 MHz band to be used for 5G services including compensation for incumbents and conversion of specific satellite services to fibre.[31]

International Context

It is important to keep in mind the broader national context when considering information on international developments. For example, for some of the countries examined the announced or expected allocations are for their first mid-band '5G' allocations in the 3.3–4.2 GHz frequency range. In contrast, some countries are investigating additional allocations for 5G in this range and/or have made available other bands for 'mid-band' 5G, for example, in the 4.4–5 GHz range. Similarly, some countries have focussed their initial 5G releases in the higher mmWave bands.

In Australia, the ACMA has already allocated the 3400–3700 MHz for WBB use. This is in addition to spectrum in many other bands such as 700 MHz, 850 MHz, 900 MHz, 2.1 GHz, 2.3 GHz and 2.5 GHz bands. Due to the technologically flexible nature of licences issued, provided licensees comply with the relevant licence conditions, the licences issued in these bands can also be used to deploy 5G services. While this would be dependent on equipment availability, it is purely a commercial decision for licensees to make.

1. Are there any other international developments in the 3700–4200 MHz band that the ACMA should be aware of?

[30] https://c-bandalliance.com/documents/c-band-alliance-proposal-fact-sheet/, CBA 8 May 2019.

[31] ACA submission to the FCC

Domestic considerations

There is interest in accessing the 3700–4200 MHz band by several different, and potentially competing, uses. These interests include:

> incumbent services in the band (point-to-point links, FSS earth stations, radiodetermination and LIPD devices)

> prospective new WBB services.

This section provides an overview of the interest each of these services has in the 3700–4200 MHz band.

The ACMA is seeking feedback from stakeholders to better understand the future needs of incumbent services in the 3700–4200 MHz band, potential viable alternative options for incumbent services and interest in using the 3700–4200 MHz for new services. This information will help inform the ACMA's thinking on whether arrangements in the band should be reviewed and, if so, what the major factors to consider are.

Fixed service (point-to-point links)

Point-to-point links are currently licensed for operation across the 3700–4200 MHz band areas Australia-wide. However, historical RRL data shows that the number of licences has been in decline for the last 20 years (refer to Table 3 in the *Current use and arrangements* section). The ACMA is interested in understanding the future requirements of point-to-point links in the 3700–4200 MHz band.

The ACMA has identified the following alternative planning options for point-to-point links in the 3700–4200 MHz band that could be investigated:

> Develop arrangements to support access to the entire 3700–4200 MHz band for both point-to-point links and other services. This could be on a first-in-time coordinated basis.

> Restack some or all point-to-point licences into one or more segments of the 3700–4200 MHz band. The other part or parts of the band could be considered for use by other services.

> Relocate some or all point-to-point licences from the band. This could be implemented either by moving to a different band (RALI FX3 defines arrangements for point-to-point links in various bands above 6 GHz) or adopting alternative delivery methods (e.g. fibre).

Various combinations of the above planning options could also be investigated based on different frequency and geographical considerations.

It is noted that some point-to-point licences in the 3700–4200 MHz band provide service over water paths, use all available channels on a path and/or are located in relatively remote areas. Due to these factors, the ACMA acknowledges there may be some links that cannot practically be restacked or re-located to higher frequencies and other options such as fibre may not be available or would be too costly to reasonably implement. The ACMA seeks feedback from licensees to help identify licensed services potentially affected by these issues.

FSS

Individual FSS earth station receivers are currently apparatus licensed for operation on across a specified frequency range within the 3700–4200 MHz band at a specific location within Australia. The ACMA understands that existing uses include:

> receive only systems for the reception of broadcasting and related program interchange

> satellite gateways or teleports involving the reception of large amounts of data traffic (with corresponding uplink transmissions in the 5925–6425 MHz band)

> standalone earth station receivers (with corresponding uplink transmissions in the 5925–6425 MHz band) providing data backhaul for businesses where fibre is not a practical option

> transfer orbit satellite services (TOSS), in-orbit testing as well as telemetry, tracking and control (TT&C) information for satellites.

In the last few years RRL data shows that the number of FSS earth station apparatus licences, including the average total licensed bandwidth of these licences, has decreased. The ACMA is interested in understanding the current and future requirements of the FSS in the 3700–4200 MHz band. This will help inform the development of future options for the service in the band in the event arrangements for WBB are considered.

The ACMA has identified the following alternative planning options for licensed FSS services in the 3700–4200 MHz band that could be investigated:

> Development of arrangements to support access to the entire 3700–4200 MHz band for both FSS earth stations and other services. This could be on a first-in-time coordinated basis or via the implementation of dynamic sharing techniques.

> Restacking some or all licenced FSS earth stations into one or more segments of the 3700–4200 MHz band in defined areas (such as significant population centres). The other part or parts of the band could be considered for use by other services.

> Relocating some or all licensed FSS earth stations in defined geographical areas (such as significant population centres) to one of the ESPZs defined in RALI MS44.

> Relocating services to a different band, such as Ku band where possible, or moving to an alternate delivery technology, such as fibre.

Various combinations of the above planning options could also be investigated based on different frequency and geographical considerations.

The ACMA also understands that FSS earth stations will have varying degrees of ability to implement these options and, in some cases, it may not be practical for a service to implement any. The ACMA seeks feedback from current and prospective FSS earth station licensees to help identify licensed services potentially affected by such issues.

2. What are the future requirements of point-to-point links and FSS earth stations in the 3700–4200 MHz band? Does this differ by geographical area and/or segment of the band?

3. If licensed point-to-point links and FSS earth stations are affected by replanning activities in the 3700–4200 MHz band, what alternative deployment options could be considered?

TVRO systems

TVRO systems operate in the broader 3400–4200 MHz band on an opportunistic basis in Australia. They are not afforded protection from interference unless they take out an apparatus licence. The ACMA does not propose any change to this policy as part of the review of arrangements in the 3700–4200 MHz.

In the event interference does occur, the owner of the TVRO system may consider mitigation techniques such as RF filtering and/or site shielding where practicable. Further information on the rights of TVRO users and possible mitigation measures is available on the ACMA website.

Radiodetermination

Existing licensed radiodetermination services are only authorised to operate at one remote location in the NT. The ACMA does not propose to modify these licenses or place additional restrictions on them as part of any replanning process. Any new arrangements would take this into account and operate on a 'no interference and no protection' basis with existing radiodetermination licences. Given the radiodetermination licences are in remote areas and use is typically on an intermittent basis, this is not expected to have a significant impact on other services. This is due to the quanta of spectrum being considered and the expected low demand for new services in the area.

Low interference potential devices

Devices authorised to operate in the 3700–4200 MHz band in accordance with the LIPD (UWB, building material analysis transmitters) are considered to have low interference potential to other services. They are also subject to the following:

> transmitters, whether on their own or in operation with one or more other transmitters, must not cause interference to the operation of other radiocommunications services

> receivers are not afforded protection from interference caused by other radiocommunications devices.

Interference to or from other services in the 3700–4200 MHz band from LIPD devices is not expected to be significant. LIPD devices currently coexist with point-to-point links and FSS earth stations. The ACMA has also previously consulted on and implemented arrangements that enable WBB and LIPD devices to share the directly adjacent 3400–3700 MHz band. Consequently, the ACMA does not propose to change the existing LIPD arrangements to remove or further limit use of the 3700–4200 MHz band by UWB and building material analysis devices.

4. In the event arrangements are made for new services in the 3700–4200 MHz band, do stakeholders have any comments on the ACMA's proposal to maintain the existing arrangements for Radiodetermination and LIPD devices, and the existing policy around TVRO systems?

WBB services

Several submissions to the draft FYSO indicated interest in accelerating consideration of the 3700–3800 MHz frequency range for use by fixed and mobile WBB services.

Interest was also expressed in the development of arrangements for both local area apparatus licensed and wide-area WBB (often implemented via spectrum licensing) use. Typically, arrangements for local area use has been of interest to WISPs, local

councils, utility companies and miners, while interest from wide-area use has come from Mobile Network Operators (MNOs) and companies such as NBN Co that deploy services covering numerous towns, cities and roads.

5. What are the future requirements for WBB services in the 3700–4200 MHz band and what arrangements should be considered? Does this differ by geographical area and/or segment of the band?

The ecosystem for mobile WBB equipment in the 3700–4200 MHz band is still evolving. GSA's online database of mobile broadband devices (GAMBoD) reports that as of 20 June 2019 there were 198 LTE devices (routers, femtocells, phones, tablets, outdoor customer premise equipment) that operate in the 3600–3800 MHz band. As of 2019, 5G user terminals that operate in the 3300–3800 MHz band are becoming more available and the number of devices is expected to increase in the coming years. 5G equipment that operates over the 3300–4200 MHz band is likely to become more prevalent from 2020.[32]

While 3GPP (LTE and 5G) compliant equipment can be used to provide fixed wireless services, there are a number of manufacturers that provide dedicated equipment optimised for such use. Much of this equipment is capable of operating over the 3300–3800 MHz frequency range. However, as evidenced in submissions to the draft FYSO 2018-19, there is at least one manufacturer with equipment capable of operating up to 3900 MHz.

6. What WBB deployment scenarios should be considered for the 3700–4200 MHz band? Should use be limited to one scenario or should more flexible arrangements be implemented?

The ACMA has identified the following possible WBB deployment scenarios for the 3700–4200 MHz band:

> large cell fixed wireless broadband deployments for wide-area coverage

> local area fixed mobile broadband deployments for small communities, local councils, mines, campuses and other uses

> macro cell mobile wireless broadband deployments for local area or wide-area coverage

> small cell mobile broadband deployments, typically used for highly populated, indoor and other high-density applications as well as providing macro-cellular coverage infill.

It is recognised that different WBB deployment scenarios may have different interference management considerations. An example of this is in the study contained at Appendix 4 of the *Future approach to the 3.6 GHz band* options paper. This study investigated the compatibility of FSS earth stations with macro and small cell WBB deployments, both fixed and mobile, in Sydney and Perth. The results of this study are considered to also apply to the 3700–4200 MHz band.

In short, the study showed it is impractical for fixed or mobile WBB macro cell deployments to share the same spectrum with licensed FSS earth stations within a large population centre. However, it could be possible for WBB small cell deployments to coexist with FSS earth stations in the same or nearby geographical area.

[32] *Decision on Revisions to the 3500 MHz Band to Accommodate Flexible Use and Preliminary Decisions on Changes to the 3800 MHz Band*, ISED, June 2019

7.	**What is the current and planned availability of fixed and mobile WBB equipment in the 3700–4200 MHz band?**
8.	**Is there interest in the use of other new service types in the 3700–4200 MHz band?**

Band planning considerations

A series of potential future planning scenarios for the 3700–4200 MHz band are presented here to promote discussion to inform the ACMA's consideration of planning options for the band. The scenarios do not represent a preliminary ACMA view regarding the future of the band.

The scenarios share the common assumption that existing arrangements and policies for radiodetermination services, class licence arrangements for LIPD devices and policy around TVRO devices, remain in place.

In considering the band planning scenarios presented in this section, a number of questions have been identified:

9.	**What services/applications should be accommodated in the 3700–4200 MHz band?**
10.	**Which frequencies ranges should be made available for these services/applications?**
11.	**Which geographic areas should be made available for these services/applications?**
12.	**On what basis should access be provided? Should access be granted on an exclusive or shared basis, on a coordinated or uncoordinated basis, et cetera?**
13.	**What licensing mechanisms are appropriate (spectrum, apparatus or class licensing)?**

The 3700–4200 MHz band is currently in the initial investigation stage of the ACMA's planning process. As part of the work conducted at this stage, the ACMA scopes potential planning scenarios for future use of a band. Any additional development of detailed planning options will be subject to further consultation.

The scenarios identified for the future of the band have been developed in the context of:

> the impact any changes may have on incumbent services

> varying potential new service deployment scenarios

> future requirements of incumbent services

> the compatibility of new services with adjacent band services.

The ACMA is requesting further information from stakeholders on all these points to help inform its decision making.

Spectrum scenarios

The ACMA has identified a number of spectrum scenarios as part of any change in use in the 3700–4200 MHz band. Factors to be considered include:

> current use of the spectrum by incumbent services

> future requirements of incumbent services in the band

> determining whether viable alternatives exist for incumbent services

> identifying segments of the band where there is demand for new services

> ensuring that a large enough portion of spectrum could be made available to be of practical use to incumbent and/or new services.

Taking the above issues into account, the following spectrum scenarios could be considered in the 3700–4200 MHz band:

a) Provide access to the entire band for new services, on either an exclusive or shared basis

Figure 4: Spectrum scenario a1, exclusive use of the whole band by new services.

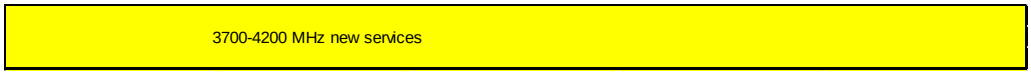


Figure 5: Spectrum scenario a2, shared used of the whole band by incumbent and new services.

b) Provide access to one or more segments of the band for new services on either an exclusive or shared basis. Maintain existing arrangements for incumbent services in the rest of the band

Figure 6: Spectrum scenario b1, exclusive use of a band segment by new services. Incumbent use only in the rest of the band.

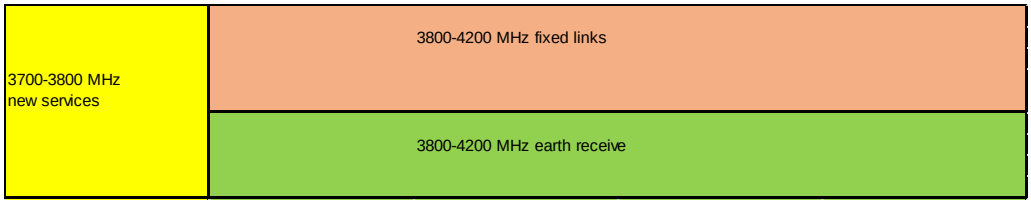
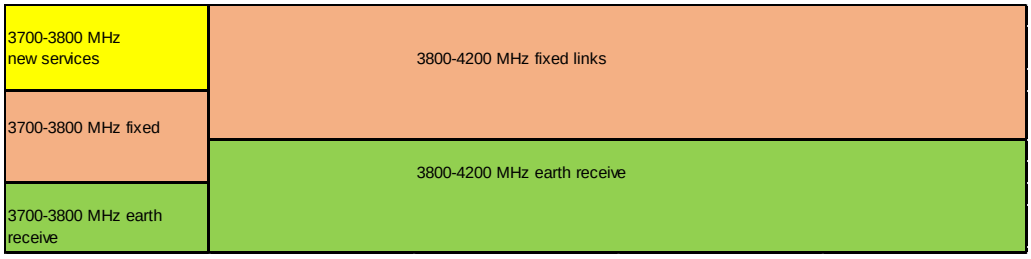
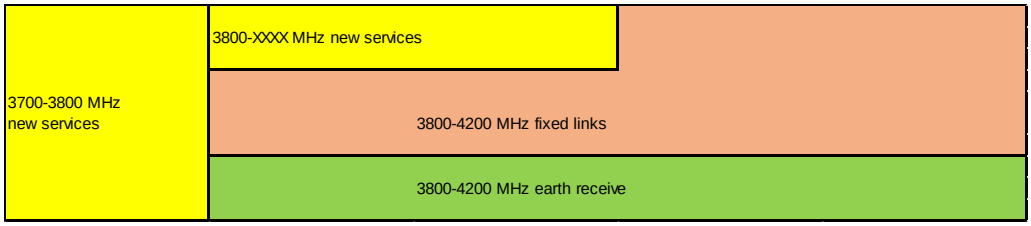


Figure 7: Spectrum scenario b2, shared used of a band segment by new services and incumbents. Incumbent use only in the rest of the band.



c) Provide access to one segment of the band on an exclusive basis to new services. Provide access for new services to another segment of the band on a shared basis. Maintain existing arrangements for incumbent services in the rest of the band

Figure 8: Spectrum scenario c, exclusive use in one band segment by new services. Shared use in another segment by new services and incumbent services. Incumbent use only in the rest of the band



d) No change to current arrangements—incumbent use only

Figure 9: Spectrum scenario d, incumbent use only

In addition to the above scenarios it may be possible to:

> Limit arrangements for new services to those parts of the band where there is demand and no (or few) licensed incumbent services. This approach could facilitate access to the band by new services while minimising the impact upon incumbent services. It affectively applies spectrum scenarios b or c in some geographic areas and spectrum scenario d in others. Inspection of the spectral occupancy charts in Appendix 2 suggest that this could be done in all or part of the band in Adelaide, Brisbane, Canberra and Melbourne. There would also be a significant amount of spectrum available for use by new services in various regional and remote areas.

> Progressively make different segments of the band available for new services. For example, given the current focus internationally and domestically appears to be on the 3700–3800 MHz segment, it may be possible to prioritise consideration of this frequency range initially. Arrangements in other segments of the band could then be progressed at a defined future point. This could provide additional time for incumbent services, if they are affected by a change in arrangements, to relocate services or investigate and implement alternative delivery mechanisms. In other words, consider spectrum scenario b initially and progress to spectrum scenario c or spectrum scenario b with more segments for new services.

Other spectrum scenarios could also be considered based on information provided by stakeholders.

Geographic scenarios

The ACMA has identified a number of geographical area planning scenarios that could be considered as part of any change in use in the 3700–4200 MHz band. These scenarios relate to the total area that could be made available for different services.

The ACMA has developed some geographical area scenarios for new services in the 3700–4200 MHz band. These areas are defined and illustrated in Appendix 1 and reproduced in Figure10 below. They are based on the areas identified for spectrum and apparatus licensing in the adjacent 3.6 GHz band. Other areas could also be considered based on information provided by stakeholders.

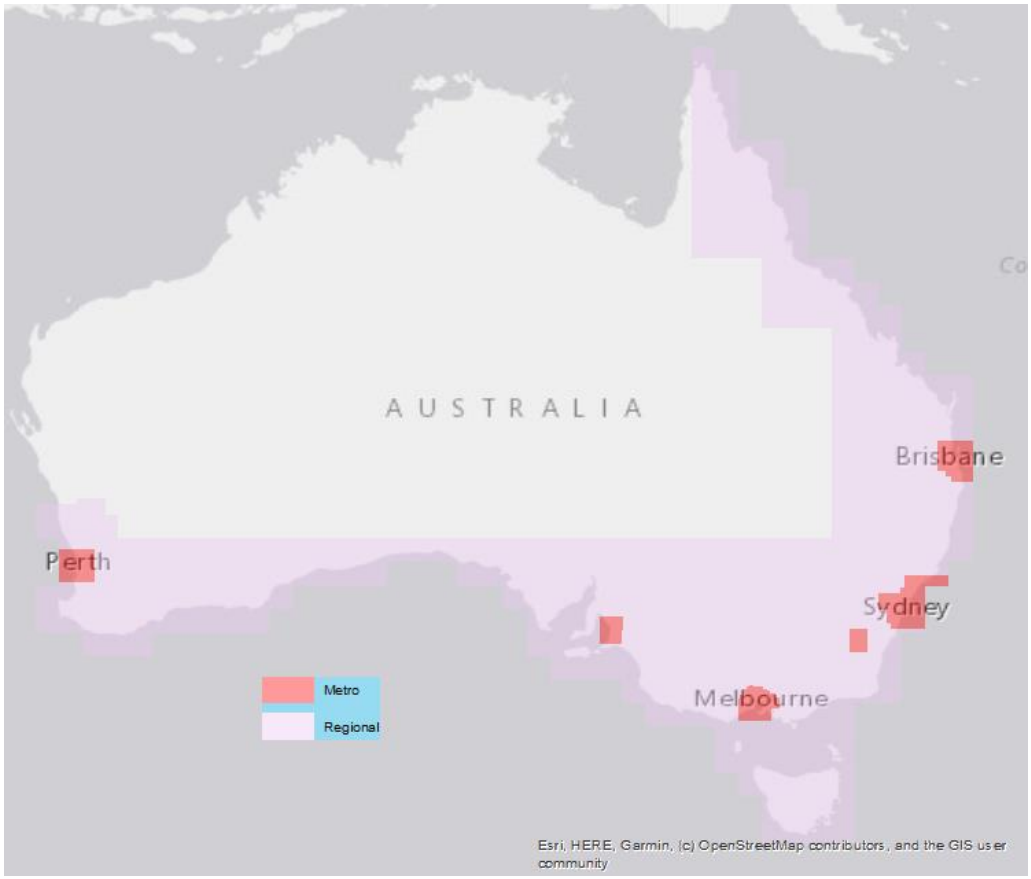
Potential geographic scenarios for any new services introduced into the 3700–4200 MHz band could include:

a) Australia-wide access, on either an exclusive or shared basis
b) provide access to defined metropolitan and regional areas, on either an exclusive or shared basis
c) provide access to defined metropolitan and regional areas on an exclusive basis, and all other areas on a shared basis
d) provide to defined metropolitan areas on an exclusive basis, and all other areas on a shared basis
e) no access provided to any areas.

One possible alternative scenario to consider would be to limit arrangements for new services to those areas that there is demand and no (or few) licensed incumbent services. This approach would facilitate access to the band by new services while minimising the impact upon incumbent services. Inspection of the spectral occupancy charts in Appendix 2 suggest that this could be done in all or part of the band in Adelaide, Brisbane, Canberra and Melbourne, i.e. consider geographical scenarios b, c or d in those areas only. There would also be a significant amount of spectrum available in regional and remote areas. It could be possible to further refine this approach and focus on making a segment of the band, such as the 3700–3800 MHz segment, available in metropolitan, regional and remote areas where there is little or no current use.

The ACMA is also interested in whether it should investigate the implementation of arrangements for new services in different areas over different timeframes. These timeframes could be developed based on consideration of both demand and incumbency issues. Such an approach would facilitate access to the band by new services and provide time for a possible relocation of incumbent services. As an example, the focus could be on implementing arrangements in some or all metropolitan areas initially, and then progressively work out to regional and remote areas. In other words, consider geographical scenario b, c or d initially but expand the defined geographical areas over time.

Figure 10: Geographical areas defined for 3700–4200 MHz band analysis



Note, as stated in numerous RALIs developed by the ACMA, additional considerations apply to any proposal for an apparatus licence in the 3700–4200 MHz band that is within 150 km the GPOs of Darwin (NT) or Geraldton (WA). These RALIs state that any request for assignments within this zone must be referred to the ACMA for assessment.

Spectrum access scenarios

If arrangements are developed for new service use in the 3700–4200 MHz band further consideration is required to determine:

> On what basis should access for new services be provided—shared or exclusive (i.e. arrangements for one service/application type only)?

> What licensing mechanism(s) are appropriate—spectrum, apparatus or class licensing?

Various combinations of the above access scenarios and licensing mechanisms can be considered for implementation in the 3700–4200 MHz band. However, some combinations are better suited than others to achieve a particular objective. For example, spectrum licensing is not typically suited to the development of shared access arrangements, nor is class licensing the best choice for exclusive access arrangements for defined users. While apparatus licensing can be adjusted to suite either exclusive or shared access arrangements it cannot be issued for the same duration as a spectrum licence.

The identified access scenarios are discussed further below.

Access models for band planning

Exclusive access

In the context of this paper, exclusive access refers to planning arrangements that support a single service or application type in a defined area and frequency range. Typically, exclusive access arrangements for a service are implemented via either the development of a local area apparatus licensing model or a spectrum licensing model in a clearly defined interference management environment. An exclusive access model requires the clearing of incumbent services in affected spectrum and geographic areas.

Shared access

The ACMA acknowledges there could be continued interest and demand from numerous incumbent services to continue operating in the 3700–4200 MHz band into the future. It may also not be practical for some incumbent services to relocate to new spectrum, areas or alternative means of delivery. One scenario to enable such services to continue operating and support the introduction of new services is to develop shared access planning arrangements in the band.

As with all forms of resource sharing, spectrum sharing requires some degree of compromise between multiple spectrum uses (that is, services or applications) and users (individual licensees) accessing the shared spectrum.

Sharing can take many different forms. At its most basic level, it could allow certain services or licences to continue operating in the 3700–4200 MHz band after new services have been introduced. Such operation may be on a primary or secondary basis, or alternatively a multi-tiered access sharing arrangement could be developed:

> If a service type or specified licence(s) continues to operate on a primary basis, any new services would need to ensure they do not cause unacceptable interference to them. This would allow incumbent licensees to continue operating in the 3700–4200 MHz band unaffected by any re-farming activities.

> If a service type or specified licence(s) continues to operate on a secondary basis, they must not cause unacceptable interference to, nor claim protection from, primary services. This would allow incumbent licensees to continue operating in the band, until a primary user deployed services in the same (or potentially nearby) area.

> In a multi-tiered approach, primary, secondary, tertiary and potentially more levels are defined for different services types or specified licences. For example, such an approach was adopted[33] by the FCC in relation to the 3.5 GHz band Citizens Broadband Radio Service (CBRS). Incumbent Access Users are protected from interference from lower tier Priority Access and General Authorised Access (GAA) tiers. GAA users are permitted to use any portion of the 3.5 GHz band not assigned to a higher tier user and may also operate opportunistically on unused Priority Access channels.

A future, dynamic shared access, regime may also be possible in the 3700–4200 MHz band. The FCC decision in relation to CBRS use of the 3.5 GHz band was based on a dynamic spectrum access model which uses an automated frequency coordinator and

[33] https://www.fcc.gov/wireless/bureau-divisions/mobility-division/35-ghz-band/35-ghz-band-citizens-broadband-radio-service.

a sensor network that detects certain transmissions[34]. It may be possible to make use of the concepts developed for CBRS and equipment developed to support it, to implement a dynamic sharing model that is optimised for Australia's specific circumstances in the 3700–4200 MHz band.

Other approaches to sharing include coordination of new and incumbent services by providing adequate geographical and frequency separation between stations, which is the traditional method used for sharing. This facilitates exclusive access for services in specific frequency ranges and geographic areas by reducing interference to an acceptable level. This could allow an incumbent service to continue operating in the band by ensuring sufficient geographical/spectral separation from new services, or by moving it to a different location. The latter approach may not be a practical solution in many cases, particularly for those services that are area/location specific. This approach mirrors the existing apparatus licence arrangements in the band for licensing earth stations and point-to-point links in the 3700–4200 MHz band. It is also the approach taken in the 1800 MHz, 2.1 GHz and 3.6 GHz (remote areas only) bands to support WBB use.

The approach taken by Ofcom in the 3800–4200 MHz band[21] enables sharing through the introduction of two licence types coordinated by a first come first served arrangement with incumbent services:

> A low power area license authorising any number of base stations within 50m of a specified location.

> A medium power per base station licence in rural areas only, where mobile terminal locations must be recorded by the licensee.

> Synchronisation between users, and between WBB services in adjacent bands was not made mandatory.

When considering if and how to implement sharing arrangements, the best solution may be different for different services/applications and/or licence types. The ACMA is open to hearing about all practical solutions.

Compatibility with adjacent band services

3575–3700 MHz band

The following arrangements are in place in the 3575–3700 MHz (3.6 GHz) band:

> In metropolitan and regional areas, the band has been re-allocated for spectrum licensing. Licences were auctioned in 2018 and will commence on 30 March 2020. The spectrum licence technical framework was optimised to support Time Division Duplex (TDD) WBB services including 5G. The ACMA has implemented arrangements for early access to the band by successful bidders via the issue of apparatus licences. A condition is that service deployment must be consistent with the spectrum licence technical framework and incumbent apparatus licensed services (including FSS earth stations and point-to-multipoint (PMP) licensees) must be protected. Incumbent apparatus licences will not be renewed beyond the re-allocation period defined by the Minister for Communications. This period ends on 30 March 2020 for major metropolitan areas (excluding Perth), 30 March 2023 for Perth and 30 March 2025 for regional areas.

[34] Noting that the specific transmissions in the US were from intermittent radar use that operate across the 3100–3700 MHz frequency range, while in Australia such use is currently limited to the 3100–3500 MHz frequency range.

> In remote areas there are arrangements for PMP apparatus licensing in place. These are used to provide fixed and mobile WBB services. There are also arrangements for FSS earth stations and the ACMA has defined several earth station protection zones that are reserved for satellite service use only. Amateur services operate in the 3575–3600 MHz band on a secondary basis. This means they operate on the basis that they cannot cause interference to or claim protection from interference from primary services, including PMP licences.

Metropolitan and regional areas

Interference between 3.6 GHz band spectrum licensees is managed via a synchronisation condition on their licences. This condition requires licensees, in the event they cause interference to another licensee and agreement cannot be reached on how to manage it, to synchronise the operation of the affected services (referred to as the synchronisation requirement). For convenience this condition is reproduced at Appendix 3.

If arrangements for WBB specifically are implemented in the 3700–4200 MHz band, the ACMA considers that:

> Applying the synchronisation requirement to any WBB use in the 3700–4200 MHz band will be sufficient to manage interference between 3.6 GHz band spectrum licences. This also avoids the need for large guard bands and/or the fitting of filters to systems to manage interference. This can be complicated and costly to incorporate into new active antenna systems.

> Interference to incumbent FSS earth station and PMP apparatus licences could be managed via the same mechanisms used by 3.6 GHz band spectrum licensees. These are defined in the *Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters—3.4 GHz Band) 2015*. It is noted that, pending identification of the frequencies made available for WBB use, the assumed filter performance of FSS earth stations in these guidelines may need to be reviewed.

Remote areas

Frequency assignment requirements for PMP apparatus licences are contained in RALI FX19—*Frequency Coordination and Licensing Procedures for apparatus licensed Broadband Wireless Access Services in the 1900–1920 and 3575–3700 MHz band*. Adjacent channel interference between PMP apparatus licences is managed by clause 11T of the Radiocommunications Licence Conditions (Fixed Licence) Determination 2015. This condition states that it is up to licensees to manage interference between TDD WBB systems. There are various mechanisms to achieve this, including synchronising the operation of devices.

The ACMA recognises this typically requires negotiation between licensees that deploy services in the same or nearby area. Due to the low density of deployments it is considered an effective and flexible means of managing interference. If arrangements for WBB are implemented in the 3700–4200 MHz band, the ACMA considers that adopting this technique would be suitable for managing adjacent band interference.

Interference to FSS earth stations can be managed by same approach used by 3.6 GHz band spectrum licences in metropolitan and regional areas. The relevant protection criteria is defined in the *Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters—3.4 GHz Band) 2015*.

14.	**If arrangements for WBB specifically are implemented in the 3700–4200 MHz band, are the proposed interference management techniques with services in the 3.6 GHz band suitable? Are any other techniques**

proposed? Are there any other compatibility issues with the 3.6 GHz band the ACMA should consider?

Aligning use across the 3400–3800 MHz band

In submissions to the draft FYSO 2019–20, MNO's indicated an interest in making the 3700–3800 MHz band available for spectrum licensing in the same areas identified for 3.6 GHz band spectrum licences. It was argued that doing so would facilitate licensees gaining access to 100 MHz of contiguous spectrum holdings[35] across the broader 3400–3800 MHz band, which is within the tuneable frequency range of most existing 5G equipment. Of course, this could only be achieved by trading and re-arranging spectrum holdings via the agreement of licensees.

There is also the potential to extend the existing 3.6 GHz band PMP arrangements in remote areas above 3700 MHz as well. This would provide access to more spectrum for PMP use for multiple operators and/or higher capacity services.

15. Should the ACMA consider extending existing apparatus and spectrum licence arrangements in the 3.6 GHz band into the 3700–3800 MHz band or another segment of the 3700–4200 MHz band?

4200–4400 MHz band

The ARSP allocates the 4200–4400 MHz band to aeronautical radionavigation and aeronautical mobile receive services. Aircraft currently operate radio altimeter systems in the band in order to determine their altitude.

At WRC-15, footnote 436 was added to the aeronautical mobile allocation to state that the 4200–4400 MHz aeronautical mobile service was exclusively for the use of wireless avionics intra-communications (WAIC) to allow for the heavy and expensive wiring used in aircraft to be replaced by wireless systems.

WRC-15 also added footnote 438 to the aeronautical radio-navigation allocation. This stated that the use of the frequency band 4200–4400 MHz by the aeronautical radionavigation service is reserved exclusively for radio altimeters installed on board aircraft and for the associated transponders on the ground.

The ACMA has not yet conducted sharing and compatibility studies between possible WBB use in the 3700–4200 MHz band with WAIC and radio altimeter systems in the 4200–4400 MHz band. However, the ACMA is aware of numerous ITU-R reports and recommendations that provide characteristics of WAIC and radio altimeter systems in the 4200–4400 MHz band. These include:

- ITU-R reports:
  - M.1186 *Use of frequency band 4 200 MHz to 4 400 MHz by radio altimeters*
  - M.2197 *Technical characteristics and operational objectives for Wireless avionics intra-communications (WAIC)*
  - M.2283 *Technical characteristics and spectrum requirements of Wireless Avionics Intra-Communications systems to support their safe operation*
  - M.2319 *Compatibility analysis between wireless avionics intra-communication systems and systems in the existing services in the frequency band 4 200-4 400 MHz*

[35] This is the largest channel size supported by 3GPP compliant 5G equipment.

> ITU-R recommendations:
  > M.2059 *Operational and technical characteristics and protection criteria of radio altimeters utilizing the band 4 200-4 400 MHz*
  > M.2067 *Technical characteristics and protection criteria for Wireless Avionics Intra-Communication systems*
  > M.2085 *Technical conditions for the use of wireless avionics intra-communication systems operating in the aeronautical mobile (R) service in the frequency band 4 200- 4 400 MHz*.

Ofcom also provided the results of their initial compatibility studies between radio altimeters and WBB[36]. An ICAO study[37] is also available, as well as a Japanese language study from the SOUMU[38]. The reports come to different conclusions, consequently the ACMA has commenced an initial compatibility study. Further information is sought from stakeholders to better understand the characteristics and requirements of these systems, as well as potential WBB systems in the 3700–4200 MHz band. This includes any sharing studies that may have been performed. This will assist in determining what spectrum scenarios could be considered for WBB and, if required, the development of appropriate interference management criteria.

16. Is there any additional information available that would assist the ACMA in assessing compatibly of potential new WBB services in the 3700–4200 MHz band with WAIC and radio altimeter systems in the 4200–4400 MHz band?

[36] *Enabling opportunities for innovation: Shared access to spectrum supporting mobile technology*, Ofcom, 18 December 2018.

[37] ICAO preliminary study into Radio Altimeter Adjacent Band Compatibility.

[38] See pages 85-104 of http://www.soumu.go.jp/main_content/000567504.pdf.

Invitation to comment

Making a submission

The ACMA invites comments on the issues set out in this discussion paper.

> Online submissions can be made via the comment function or by uploading a document. Submissions in Microsoft Word or Rich Text Format are preferred.

> Submissions by post can be sent to:

The Manager
Spectrum Planning Section
Spectrum Infrastructure Branch
Australian Communications and Media Authority
PO Box 78
Belconnen ACT 2616

The closing date for submissions is COB, 13 September 2019.

Consultation enquiries can be emailed to freqplan@acma.gov.au.

Publication of submissions

The ACMA publishes 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.

Privacy

Privacy and consultation provides information about the ACMA's collection of personal information during consultation and how we handle that information.

Information on the *Privacy Act 1988* and the ACMA's privacy policy (including how to access or correct personal information, how to make a privacy complaint and how we will deal with the complaint) is available at acma.gov.au/privacypolicy.

Glossary

Term	Definition
3.6 GHz band	Refers to the 3575–3700 MHz frequency range
3GPP	3rd Generation Partnership Project An international body responsible for the standardisation of (cellular) mobile (including broadband) telecommunications, including the 2G, 3G, 4G and (soon) 5G technology standards.
Apparatus licence	An apparatus licence authorises, under the *Radiocommunications Act 1992*, the use of a radiocommunications device under a particular service type, in a particular frequency range and at a particular geographic location for a period of up to five years.
ASMG	Australian Spectrum Map Grid Used to define geographical areas over which spectrum licences are issued. The HCIS is used to define the cells that make up the ASMG. The ASMG is described in detail in the document: The Australian spectrum map grid 2012. *See also* HCIS.
Class licence	A standing authorisation for the operation of an unlimited number of radiocommunications devices operating within a set of conditions specified within the authorisation.
Coordination	The process of assessing the interference potential existing licensed services and a proposed new service will have on each other. Coordination is deemed to fail if the level of interference exceeds the specified protection criteria for the services involved.
DSA	Dynamic spectrum access
Embargo	A spectrum embargo is a policy notice of intent by the ACMA to restrict the allocation of new licences in a particular frequency range to support replanning of that frequency range. Spectrum may still be able to be accessed on an exceptional basis through an application for an exemption to the embargo.
HCIS	Hierarchical Cell Identification Scheme A naming convention developed by the ACMA that applies unique 'names' to each of the cells of the ASMG. Each five-minute of arc square cell in the ASMG is assigned a unique identifier, derived from the cell's position in a hierarchically arranged grouping of cells. The hierarchy has four levels. A detailed description of the HCIS is available on the ACMA website. *See also* ASMG.
FSS	Fixed satellite service
FWA	Fixed wireless access
MBB	Mobile broadband

Term	Definition
HVU	Highest value use When applied to spectrum, is the use for which spectrum can provide the greatest incremental value to economic welfare. The value provided to the economy by spectrum is typically due to reduced costs for spectrum users to provide services, or the ability to provide new services that would not be possible without the use of particular spectrum.
Principles for spectrum management	A set of principles developed by the ACMA to guide its approach to spectrum management. The key theme of the principles is that maximising the overall public benefit from use of the radiofrequency spectrum requires balanced application of both regulatory and market mechanisms. Details of the principles are available on the ACMA website.
PMP	Point-to-multipoint
PTS	Public telecommunications service
Re-allocation of spectrum	Under section 153B of the *Radiocommunications Act 1992*, the minster can re-allocate specific frequencies and areas for the issue of spectrum (or apparatus) licences. A result of this process is the cancellation of incumbent apparatus licences in the identified areas at the end of a defined timeframe known as the re-allocation period.
Re-allocation period	The period of time before incumbent apparatus licenses that fall wholly or partially within the frequencies and areas to be re-allocated under section 153B of the *Radiocommunications Act 1992* will be cancelled. The re-allocation period is required to be a minimum of two years.
Spectrum licence	Issued under the *Radiocommunications Act 1992* and authorises the use of a particular frequency band within a particular geographic area for a period of up to 15 years. The geographic area can vary in size, up to and including the entire country.
TDD	Time Division Duplex A technique where downlink and uplink communications use the same frequency but are separated by the allocation of different slots. This means uplink and downlink communications cannot occur at the same time.
WBB	Wireless broadband
WISP	Wireless Internet Service Provider

Appendix 1: Geographical area descriptions

The ACMA has defined geographical areas to assist in the analysis of use of, and potential future use scenarios for, the 3700–4200 MHz band. These areas are displayed in Figure 11. A brief description of each follows:

> Metropolitan—covers all capital cities (except Darwin and Hobart). It mirrors the metro areas defined in the Radiocommunications (Spectrum Re-allocation—3.6 GHz Band for Adelaide and Eastern Metropolitan Australia) Declaration 2018 and the Radiocommunications (Spectrum Re-allocation—3.6 GHz Band for Perth) Declaration 2018.

> Regional—mirrors the regional areas subject to spectrum licensing in the 3.6 GHz band as defined in the Radiocommunications (Spectrum Re-allocation—Regional 1800 MHz Band) Declaration 2015.

> Remote—includes those areas of Australia not covered by metropolitan and Regional areas.

> Australia-wide—covers all of Australia but excludes Australian external territories.

The Australian Spectrum Map Grid (ASMG) is used to define geographical areas over which spectrum licences are issued. The Hierarchical Cell Identification Scheme (HCIS) is a naming convention developed by the ACMA that applies unique 'names' to each of the cells that make up the ASMG. The ASMG and HCIS are described in detail in the document *The Australian spectrum map grid 2012*.

The HCIS coordinates in HCIS description of areas can be converted into a Placemark file (viewable in Google Earth) through a facility on the ACMA website.

Figure 11: 3700–4200 MHz band geographical area descriptions

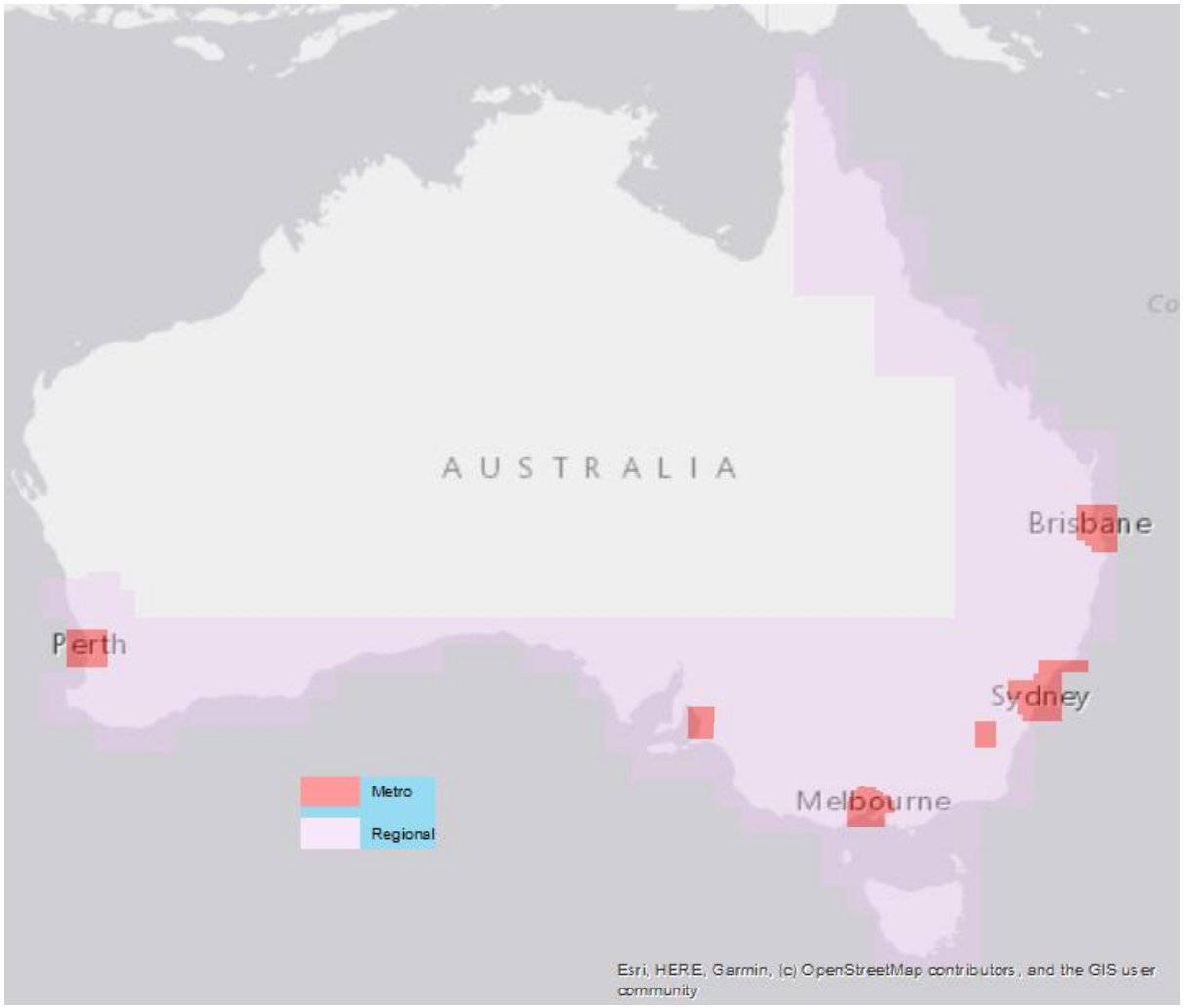


Table 8: HCIS description of areas

Area	Sub-area name	HCIS
Metropolitan	Adelaide	IW3J,IW3K,IW3L,IW3N,IW3O,IW3P,IW6B,IW6C,IW6D,IW6F,IW6G,IW6H,IW3E5,IW3E6,IW3E8,IW3E9,IW3F4,IW3F5,IW3F6,IW3F7,IW3F8,IW3F9,IW3G4,IW3G5,IW3G6,IW3G7,IW3G8,IW3G9,IW3H4,IW3H5,IW3H6,IW3H7,IW3H8,IW3H9,IW3I2,IW3I3,IW3I5,IW3I6,IW3I8,IW3I9,IW3M2,IW3M3,IW3M5,IW3M6,IW3M8,IW3M9,IW6A2,IW6A3,IW6A5,IW6A6,IW6A8,IW6A9,IW6E2,IW6E3,IW6E5,IW6E6,IW6E8,IW6E9,JW1E4,JW1E7,JW1I1,JW1I4,JW1I7,JW1M1,JW1M4
	Brisbane	NT9,NT8C,NT8D,NT8G,NT8H,NT8K,NT8L,NT8O,NT8P,NU3A,NU3B,NU3C,NU3D,NU3F,NU3G,NU3H,NT5O4,NT5O5,NT5O6,NT5O7,NT5O8,NT5O9,NT5P4,NT5P5,NT5P6,NT5P7,NT5P8,NT5P9,NT6M4,NT6M5,NT6M6,NT6M7,NT6M8,NT6M9,NT6N4,NT6N5,NT6N6,NT6N7,NT6N8,NT6N9,NT6O4,NT6O5,NT6O6,NT6O7,NT6O8,NT6O9,NT6P4,NT6P5,NT6P6,NT6P7,NT6P8,NT6P9,NU2C1,NU2C2,NU2C3,NU2D1,NU2D2,NU2D3,NU2D5,NU2D6,NU2D8,NU2D9,NU2H2,NU2H3,NU3E1,NU3E2,NU3E3,NU3E5,NU3E6,NU3E8,NU3E9,NU3I2,NU3I3,NU3J1,NU3J2,NU3J3,NU3K1,NU3K2,NU3K3,NU3L1,NU3L2,NU3L3

Area	Sub-area name	HCIS
	Canberra	MW4D,MW4H,MW4L,MW5A,MW5B,MW5E,MW5F,MW5I,MW5J,MW1P4,MW1P5,MW1P6,MW1P7,MW1P8,MW1P9,MW2M4,MW2M5,MW2M6,MW2M7,MW2M8,MW2M9,MW2N4,MW2N5,MW2N6,MW2N7,MW2N8,MW2N9,MW4P1,MW4P2,MW4P3,MW5M1,MW5M2,MW5M3,MW5N1,MW5N2,MW5N3
	Melbourne	KX3J,KX3K,KX3L,KX3N,KX3O,KX3P,KX6A,KX6B,KX6C,KX6D,KX6E,KX6F,KX6G,KX6H,KX6I,KX6J,KX6K,KX6L,LX1I,LX1M,LX1N,LX1O,LX4A,LX4B,LX4C,LX4E,LX4I,KX3E9,KX3F5,KX3F6,KX3F7,KX3F8,KX3F9,KX3G1,KX3G2,KX3G4,KX3G5,KX3G6,KX3G7,KX3G8,KX3G9,KX3H4,KX3H5,KX3H6,KX3H7,KX3H8,KX3H9,KX3I3,KX3I6,KX3I8,KX3I9,KX3M2,KX3M3,KX3M4,KX3M5,KX3M6,KX3M7,KX3M8,KX3M9,LX1E4,LX1E7,LX1E8,LX1E9,LX1J1,LX1J4,LX1J5,LX1J6,LX1J7,LX1J8,LX1J9,LX1K4,LX1K7,LX4F1,LX4F2,LX4F4,LX4F5,LX4F7,LX4F8,LX4J1,LX4J2,LX4J4,LX4J5,LX4J7,LX4J8
	Perth	BV1I,BV1J,BV1K,BV1L,BV1M,BV1N,BV1O,BV1P,BV2I,BV2J,BV2M,BV2N,BV4A,BV4B,BV4C,BV4D,BV4E,BV4F,BV4G,BV4H,BV4I,BV4J,BV4K,BV4L,BV5A,BV5B,BV5E,BV5F,BV5I,BV5J,BV1E7,BV1E8,BV1E9,BV1F7,BV1F8,BV1F9,BV1G7,BV1G8,BV1G9,BV1H7,BV1H8,BV1H9,BV2E7,BV2E8,BV2E9,BV2F7,BV2F8,BV2F9,BV4M1,BV4M2,BV4M3,BV4N1,BV4N2,BV4N3,BV4O1,BV4O2,BV4O3,BV4P1,BV4P2,BV4P3,BV5M1,BV5M2,BV5M3,BV5N1,BV5N2,BV5N3
	Sydney	MV9I,MV9J,MV9K,MV9L,MV9M,MV9N,MV9O,MV9P,MW3C,MW3D,MW3G,MW3H,MW3K,MW3L,NV4N,NV4O,NV4P,NV5M,NV5N,NV5O,NV5P,NV7B,NV7C,NV7D,NV7E,NV7F,NV7G,NV7H,NV7I,NV7J,NV7K,NV7L,NV7M,NV7N,NV7O,NV7P,NW1A,NW1B,NW1C,NW1D,NW1E,NW1F,NW1G,NW1H,NW1I,NW1J,NW1K,NW1L,MV9D6,MV9D9,MV9E4,MV9E5,MV9E6,MV9E7,MV9E8,MV9E9,MV9F4,MV9F5,MV9F6,MV9F7,MV9F8,MV9F9,MV9G4,MV9G5,MV9G6,MV9G7,MV9G8,MV9G9,MV9H3,MV9H4,MV9H5,MV9H6,MV9H7,MV9H8,MV9H9,MW3B2,MW3B3,MW3B5,MW3B6,MW3B8,MW3B9,MW3F2,MW3F3,MW3F5,MW3F6,MW3F8,MW3F9,MW3J2,MW3J3,MW3O1,MW3O2,MW3O3,MW3P1,MW3P2,MW3P3,NV4I5,NV4I6,NV4I8,NV4I9,NV4J4,NV4J5,NV4J6,NV4J7,NV4J8,NV4J9,NV4K4,NV4K5,NV4K6,NV4K7,NV4K8,NV4K9,NV4L4,NV4L5,NV4L6,NV4L7,NV4L8,NV4L9,NV4M2,NV4M3,NV4M5,NV4M6,NV4M8,NV4M9,NV5I4,NV5I5,NV5I6,NV5I7,NV5I8,NV5I9,NV5J4,NV5J5,NV5J6,NV5J7,NV5J8,NV5J9,NV5K4,NV5K5,NV5K6,NV5K7,NV5K8,NV5K9,NV5L4,NV5L5,NV5L6,NV5L7,NV5L8,NV5L9,NV7A2,NV7A3,NV7A4,NV7A5,NV7A6,NV7A7,NV7A8,NV7A9,NW1M1,NW1M2,NW1M3,NW1N1,NW1N2,NW1N3,NW1O1,NW1O2,NW1O3,NW1P1,NW1P2,NW1P3
Regional	-	CV,DV,IV,JV,KQ,KV,KW,LR,LV,LW,LY,MS,MT,MU,AU9,AV9,AW3,BU7,BU8,BV3,BV6,BV7,BV8,BV9,BW1,BW2,BW3,BW5,BW6,CW1,CW2,CW3,CW4,DW1,DW2,DW3,EV1,EV2,EV3,EV4,EV5,EV6,EV7,FV1,FV2,FV3,FV4,FV5,GV1,GV2,GV3,GV6,HV1,HV2,HV3,HV4,HV5,HV6,HV8,HV9,HW3,HW6,IW1,IW2,IW4,IW5,IW7,IW8,IW9,JW2,JW3,JW4,JW5,JW6,JW7,JW8,JW9,JX1,JX2,JX3,JX5,JX6,KO1,KO4,KO5,KO7,KO8,KP1,KP2,KP4,KP5,KP6,KP7,KP8,KP9,KX1,KX2,KX4,KX5,KX8,KX9,KY2,KY3,KY6,LP4,LP7,LQ1,LQ2,LQ4,LQ5,LQ7,LQ8,LX2,LX3,LX5,LX6,LX7,LX8,LX9,LZ1,LZ2,LZ3,MR1,MR4,MR5,MR7,MR8,MR9,MV1,MV2,MV3,MV4,MV5,MV6,MV7,MV8,MW6,MW7,MW8,MW9,MX1,MX2,MX3,MX4,MX7,MY1,MY4,MY7,MZ1,NS4,NS7,NS8,NS9,NT1,NT2,NT3,NT4,NT7,NU1,NU4,NU5,NU6,NU7,NU8,NU9,NV1,NV2,NV3,AU6I,AU6J,AU6K,AU6L,AU6M,AU6N,AU6O,AU6P,BU4H,BU4I,BU4J,BU4K,BU4L,BU4M,BU4N,BU4O,BU4P,BU5E,BU5F,BU5G,BU5H,BU5I,BU5J,BU5K,BU5L,BU5M,BU5N,BU5O,BU5P,BU9A,BU9B,BU9E,BU9F,BU9I,BU9J,BU9M,BU9N,BV1A,BV1B,BV1C,BV1D,BV2A,BV2B,BV2C,BV2D,BV2G,BV2H,BV2K,BV2L,BV2O,BV2P,BV5C,BV5D,BV5G,BV5H,BV5K,BV5L,BV5O,BV5P,IW3A,IW3B,IW3C,IW3D,IW6I,IW6J,IW6K,IW6L,IW6M,IW6

Area	Sub-area name	HCIS
		N,IW6O,IW6P,JW1A,JW1B,JW1C,JW1D,JW1F,JW1G,JW1H,JW1J,JW1K,JW1L,JW1N,JW1O,JW1P,KX3A,KX3B,KX3C,KX3D,KX6M,KX6N,KX6O,KX6P,LX1A,LX1B,LX1C,LX1D,LX1F,LX1G,LX1H,LX1L,LX1P,LX4D,LX4G,LX4H,LX4K,LX4L,LX4M,LX4N,LX4O,LX4P,MV9A,MV9B,MV9C,MW1A,MW1B,MW1C,MW1D,MW1E,MW1F,MW1G,MW1H,MW1I,MW1J,MW1K,MW1L,MW1M,MW1N,MW1O,MW2A,MW2B,MW2C,MW2D,MW2E,MW2F,MW2G,MW2H,MW2I,MW2J,MW2K,MW2L,MW2O,MW2P,MW3A,MW3E,MW3I,MW3M,MW3N,MW4A,MW4B,MW4C,MW4E,MW4F,MW4G,MW4I,MW4J,MW4K,MW4M,MW4N,MW4O,MW5C,MW5D,MW5G,MW5H,MW5K,MW5L,MW5O,MW5P,NT5A,NT5B,NT5C,NT5D,NT5E,NT5F,NT5G,NT5H,NT5I,NT5J,NT5K,NT5L,NT5M,NT5N,NT6A,NT6B,NT6C,NT6D,NT6E,NT6F,NT6G,NT6H,NT6I,NT6J,NT6K,NT6L,NT8A,NT8B,NT8E,NT8F,NT8I,NT8J,NT8M,NT8N,NU2A,NU2B,NU2E,NU2F,NU2G,NU2I,NU2J,NU2K,NU2L,NU2M,NU2N,NU2O,NU2P,NU3M,NU3N,NU3O,NU3P,NV4A,NV4B,NV4C,NV4D,NV4E,NV4F,NV4G,NV4H,NV5A,NV5B,NV5C,NV5D,NV5E,NV5F,NV5G,NV5H,BV1E1,BV1E2,BV1E3,BV1E4,BV1E5,BV1E6,BV1F1,BV1F2,BV1F3,BV1F4,BV1F5,BV1F6,BV1G1,BV1G2,BV1G3,BV1G4,BV1G5,BV1G6,BV1H1,BV1H2,BV1H3,BV1H4,BV1H5,BV1H6,BV2E1,BV2E2,BV2E3,BV2E4,BV2E5,BV2E6,BV2F1,BV2F2,BV2F3,BV2F4,BV2F5,BV2F6,BV4M4,BV4M5,BV4M6,BV4M7,BV4M8,BV4M9,BV4N4,BV4N5,BV4N6,BV4N7,BV4N8,BV4N9,BV4O4,BV4O5,BV4O6,BV4O7,BV4O8,BV4O9,BV4P4,BV4P5,BV4P6,BV4P7,BV4P8,BV4P9,BV5M4,BV5M5,BV5M6,BV5M7,BV5M8,BV5M9,BV5N4,BV5N5,BV5N6,BV5N7,BV5N8,BV5N9,IW3E1,IW3E2,IW3E3,IW3E4,IW3E7,IW3F1,IW3F2,IW3F3,IW3G1,IW3G2,IW3G3,IW3H1,IW3H2,IW3H3,IW3I1,IW3I4,IW3I7,IW3M1,IW3M4,IW3M7,IW6A1,IW6A4,IW6A7,IW6E1,IW6E4,IW6E7,JW1E1,JW1E2,JW1E3,JW1E5,JW1E6,JW1E8,JW1E9,JW1I2,JW1I3,JW1I5,JW1I6,JW1I8,JW1I9,JW1M2,JW1M3,JW1M5,JW1M6,JW1M7,JW1M8,JW1M9,KX3E1,KX3E2,KX3E3,KX3E4,KX3E5,KX3E6,KX3E7,KX3E8,KX3F1,KX3F2,KX3F3,KX3F4,KX3G3,KX3H1,KX3H2,KX3H3,KX3I1,KX3I2,KX3I4,KX3I5,KX3I7,KX3M1,LX1E1,LX1E2,LX1E3,LX1E5,LX1E6,LX1J2,LX1J3,LX1K1,LX1K2,LX1K3,LX1K5,LX1K6,LX1K8,LX1K9,LX4F3,LX4F6,LX4F9,LX4J3,LX4J6,LX4J9,MV9D1,MV9D2,MV9D3,MV9D4,MV9D5,MV9D7,MV9D8,MV9E1,MV9E2,MV9E3,MV9F1,MV9F2,MV9F3,MV9G1,MV9G2,MV9G3,MV9H1,MV9H2,MW1P1,MW1P2,MW1P3,MW2M1,MW2M2,MW2M3,MW2N1,MW2N2,MW2N3,MW3B1,MW3B4,MW3B7,MW3F1,MW3F4,MW3F7,MW3J1,MW3J4,MW3J5,MW3J6,MW3J7,MW3J8,MW3J9,MW3O4,MW3O5,MW3O6,MW3O7,MW3O8,MW3O9,MW3P4,MW3P5,MW3P6,MW3P7,MW3P8,MW3P9,MW4P4,MW4P5,MW4P6,MW4P7,MW4P8,MW4P9,MW5M4,MW5M5,MW5M6,MW5M7,MW5M8,MW5M9,MW5N4,MW5N5,MW5N6,MW5N7,MW5N8,MW5N9,NT5O1,NT5O2,NT5O3,NT5P1,NT5P2,NT5P3,NT6M1,NT6M2,NT6M3,NT6N1,NT6N2,NT6N3,NT6O1,NT6O2,NT6O3,NT6P1,NT6P2,NT6P3,NU2C4,NU2C5,NU2C6,NU2C7,NU2C8,NU2C9,NU2D4,NU2D7,NU2H1,NU2H4,NU2H5,NU2H6,NU2H7,NU2H8,NU2H9,NU3E4,NU3E7,NU3I1,NU3I4,NU3I5,NU3I6,NU3I7,NU3I8,NU3I9,NU3J4,NU3J5,NU3J6,NU3J7,NU3J8,NU3J9,NU3K4,NU3K5,NU3K6,NU3K7,NU3K8,NU3K9,NU3L4,NU3L5,NU3L6,NU3L7,NU3L8,NU3L9,NV4I1,NV4I2,NV4I3,NV4I4,NV4I7,NV4J1,NV4J2,NV4J3,NV4K1,NV4K2,NV4K3,NV4L1,NV4L2,NV4L3,NV4M1,NV4M4,NV4M7,NV5I1,NV5I2,NV5I3,NV5J1,NV5J2,NV5J3,NV5K1,NV5K2,NV5K3,NV5L1,NV5L2,NV5L3,NV7A1,NW1M4,NW1M5,NW1M6,NW1M7,NW1M8,NW1M9,NW1N4,NW1N5,NW1N6,NW1N7,NW1N8,NW1N9,NW1O4,NW1O5,NW1O6,NW1O7,NW1O8,NW1O9,NW1P4,NW1P5,NW1P6,NW1P7,NW1P8,NW1P9,MT4H,MT4K,MT4L,MU5G,MU5H,MU5L,MV3G,MV3H,MV3K,MV3L,MT4F9,MT4G2,MT4G3,MT4G4,MT4G5,MT4G6,MT4G7,MT4G8,MT4G9,MT4J3,MT4J6,MT4O1,MT4O2,MT4O3,MT4O6,MT4P1,MT4P2,MT4P3,MT4P4,MT4P5,MT5E4,MT5E7,MT5I1,MT5I2,MT5I4,MT5I5,MT5I7,

Area	Sub-area name	HCIS
		MT5M1,MU5C8,MU5C9,MU5D7,MU5D8,MU5D9,MU5K1,MU5K2,MU5K3,MU5K4,MU5K5,MU5K6,MU5K8,MU5K9,MU6A7,MU6E1,MU6E2,MU6E4,MU6E5,MU6E7,MU6E8,MU6I1,MU6I2,MU6I4,MU6I5,MU6I7,MV3C8,MV3C9,MV3D7,MV3F3,MV3F5,MV3F6,MV3F8,MV3F9,MV3J2,MV3J3,MV3J5,MV3J6,MV3J9,MV3O1,MV3O2,MV3O3,MV3P1,NU7K4,CV,DV,IV,JV,KQ,KV,KW,LR,LV,LW,LY,MS,AU9,AV9,AW3,BU7,BU8,BV3,BV6,BV7,BV8,BV9,BW1,BW2,BW3,BW5,BW6,CW1,CW2,CW3,CW4,DW1,DW2,DW3,EV1,EV2,EV3,EV4,EV5,EV6,EV7,FV1,FV2,FV3,FV4,FV5,GV1,GV2,GV3,GV6,HV1,HV2,HV3,HV4,HV5,HV6,HV8,HV9,HW3,HW6,IW1,IW2,IW4,IW5,IW7,IW8,IW9,JW2,JW3,JW4,JW5,JW6,JW7,JW8,JW9,JX1,JX2,JX3,JX5,JX6,KO1,KO4,KO5,KO7,KO8,KP1,KP2,KP4,KP5,KP6,KP7,KP8,KP9,KX1,KX2,KX4,KX5,KX8,KX9,KY2,KY3,KY6,LP4,LP7,LQ1,LQ2,LQ4,LQ5,LQ7,LQ8,LX2,LX3,LX5,LX6,LX7,LX8,LX9,LZ1,LZ2,LZ3,MR1,MR4,MR5,MR7,MR8,MR9,MT1,MT2,MT3,MT6,MT7,MT8,MT9,MU1,MU2,MU3,MU4,MU7,MU8,MU9,MV1,MV2,MV4,MV5,MV6,MV7,MV8,MW6,MW7,MW8,MW9,MX1,MX2,MX3,MX4,MX7,MY1,MY4,MY7,MZ1,NS4,NS7,NS8,NS9,NT1,NT2,NT3,NT4,NT7,NU1,NU4,NU5,NU6,NU8,NU9,NV1,NV2,NV3,AU6I,AU6J,AU6K,AU6L,AU6M,AU6N,AU6O,AU6P,BU4H,BU4I,BU4J,BU4K,BU4L,BU4M,BU4N,BU4O,BU4P,BU5E,BU5F,BU5G,BU5H,BU5I,BU5J,BU5K,BU5L,BU5M,BU5N,BU5O,BU5P,BU9A,BU9B,BU9E,BU9F,BU9I,BU9J,BU9M,BU9N,BV1A,BV1B,BV1C,BV1D,BV2A,BV2B,BV2C,BV2D,BV2G,BV2H,BV2K,BV2L,BV2O,BV2P,BV5C,BV5D,BV5G,BV5H,BV5K,BV5L,BV5O,BV5P,IW3A,IW3B,IW3C,IW3D,IW6I,IW6J,IW6K,IW6L,IW6M,IW6N,IW6O,IW6P,JW1A,JW1B,JW1C,JW1D,JW1F,JW1G,JW1H,JW1J,JW1K,JW1L,JW1N,JW1O,JW1P,KX3A,KX3B,KX3C,KX3D,KX6M,KX6N,KX6O,KX6P,LX1A,LX1B,LX1C,LX1D,LX1F,LX1G,LX1H,LX1L,LX1P,LX4D,LX4G,LX4H,LX4K,LX4L,LX4M,LX4N,LX4O,LX4P,MT4A,MT4B,MT4C,MT4D,MT4E,MT4I,MT4M,MT4N,MT5A,MT5B,MT5C,MT5D,MT5F,MT5G,MT5H,MT5J,MT5K,MT5L,MT5N,MT5O,MT5P,MU5A,MU5B,MU5E,MU5F,MU5I,MU5J,MU5M,MU5N,MU5O,MU5P,MU6B,MU6C,MU6D,MU6F,MU6G,MU6H,MU6J,MU6K,MU6L,MU6M,MU6N,MU6O,MU6P,MV3A,MV3B,MV3E,MV3I,MV3M,MV3N,MV9A,MV9B,MV9C,MW1A,MW1B,MW1C,MW1D,MW1E,MW1F,MW1G,MW1H,MW1I,MW1J,MW1K,MW1L,MW1M,MW1N,MW1O,MW2A,MW2B,MW2C,MW2D,MW2E,MW2F,MW2G,MW2H,MW2I,MW2J,MW2K,MW2L,MW2O,MW2P,MW3A,MW3E,MW3I,MW3M,MW3N,MW4A,MW4B,MW4C,MW4E,MW4F,MW4G,MW4I,MW4J,MW4K,MW4M,MW4N,MW4O,MW5C,MW5D,MW5G,MW5H,MW5K,MW5L,MW5O,MW5P,NT5A,NT5B,NT5C,NT5D,NT5E,NT5F,NT5G,NT5H,NT5I,NT5J,NT5K,NT5L,NT5M,NT5N,NT6A,NT6B,NT6C,NT6D,NT6E,NT6F,NT6G,NT6H,NT6I,NT6J,NT6K,NT6L,NT8A,NT8B,NT8E,NT8F,NT8I,NT8J,NT8M,NT8N,NU2A,NU2B,NU2E,NU2F,NU2G,NU2I,NU2J,NU2K,NU2L,NU2M,NU2N,NU2O,NU2P,NU3M,NU3N,NU3O,NU3P,NU7A,NU7B,NU7C,NU7D,NU7E,NU7F,NU7G,NU7H,NU7I,NU7J,NU7L,NU7M,NU7N,NU7O,NU7P,NV4A,NV4B,NV4C,NV4D,NV4E,NV4F,NV4G,NV4H,NV5A,NV5B,NV5C,NV5D,NV5E,NV5F,NV5G,NV5H,BV1E1,BV1E2,BV1E3,BV1E4,BV1E5,BV1E6,BV1F1,BV1F2,BV1F3,BV1F4,BV1F5,BV1F6,BV1G1,BV1G2,BV1G3,BV1G4,BV1G5,BV1G6,BV1H1,BV1H2,BV1H3,BV1H4,BV1H5,BV1H6,BV2E1,BV2E2,BV2E3,BV2E4,BV2E5,BV2E6,BV2F1,BV2F2,BV2F3,BV2F4,BV2F5,BV2F6,BV4M4,BV4M5,BV4M6,BV4M7,BV4M8,BV4M9,BV4N4,BV4N5,BV4N6,BV4N7,BV4N8,BV4N9,BV4O4,BV4O5,BV4O6,BV4O7,BV4O8,BV4O9,BV4P4,BV4P5,BV4P6,BV4P7,BV4P8,BV4P9,BV5M4,BV5M5,BV5M6,BV5M7,BV5M8,BV5M9,BV5N4,BV5N5,BV5N6,BV5N7,BV5N8,BV5N9,IW3E1,IW3E2,IW3E3,IW3E4,IW3E7,IW3F1,IW3F2,IW3F3,IW3G1,IW3G2,IW3G3,IW3H1,IW3H2,IW3H3,IW3I1,IW3I4,IW3I7,IW3M1,IW3M4,IW3M7,IW6A1,IW6A4,IW6A7,IW6E1,IW6E4,IW6E7,JW1E1,JW1E2,JW1E3,JW1E5,JW1E6,JW1E8,JW1E9,JW1I2,JW1I3,JW1I5,JW1I6,JW1I8,JW1I9,JW1M2,JW1M3,JW1M5,JW

Area	Sub-area name	HCIS
		1M6,JW1M7,JW1M8,JW1M9,KX3E1,KX3E2,KX3E3,KX3E4,KX3E5,KX3E6,KX3E7,KX3E8,KX3F1,KX3F2,KX3F3,KX3F4,KX3G3,KX3H1,KX3H2,KX3H3,KX3I1,KX3I2,KX3I4,KX3I5,KX3I7,KX3M1,LX1E1,LX1E2,LX1E3,LX1E5,LX1E6,LX1J2,LX1J3,LX1K1,LX1K2,LX1K3,LX1K5,LX1K6,LX1K8,LX1K9,LX4F3,LX4F6,LX4F9,LX4J3,LX4J6,LX4J9,MT4F1,MT4F2,MT4F3,MT4F4,MT4F5,MT4F6,MT4F7,MT4F8,MT4G1,MT4J1,MT4J2,MT4J4,MT4J5,MT4J7,MT4J8,MT4J9,MT4O4,MT4O5,MT4O7,MT4O8,MT4O9,MT4P6,MT4P7,MT4P8,MT4P9,MT5E1,MT5E2,MT5E3,MT5E5,MT5E6,MT5E8,MT5E9,MT5I3,MT5I6,MT5I8,MT5I9,MT5M2,MT5M3,MT5M4,MT5M5,MT5M6,MT5M7,MT5M8,MT5M9,MU5C1,MU5C2,MU5C3,MU5C4,MU5C5,MU5C6,MU5C7,MU5D1,MU5D2,MU5D3,MU5D4,MU5D5,MU5D6,MU5K7,MU6A1,MU6A2,MU6A3,MU6A4,MU6A5,MU6A6,MU6A8,MU6A9,MU6E3,MU6E6,MU6E9,MU6I3,MU6I6,MU6I8,MU6I9,MV3C1,MV3C2,MV3C3,MV3C4,MV3C5,MV3C6,MV3C7,MV3D1,MV3D2,MV3D3,MV3D4,MV3D5,MV3D6,MV3D8,MV3D9,MV3F1,MV3F2,MV3F4,MV3F7,MV3J1,MV3J4,MV3J7,MV3J8,MV3O4,MV3O5,MV3O6,MV3O7,MV3O8,MV3O9,MV3P2,MV3P3,MV3P4,MV3P5,MV3P6,MV3P7,MV3P8,MV3P9,MV9D1,MV9D2,MV9D3,MV9D4,MV9D5,MV9D7,MV9D8,MV9E1,MV9E2,MV9E3,MV9F1,MV9F2,MV9F3,MV9G1,MV9G2,MV9G3,MV9H1,MV9H2,MW1P1,MW1P2,MW1P3,MW2M1,MW2M2,MW2M3,MW2N1,MW2N2,MW2N3,MW3B1,MW3B4,MW3B7,MW3F1,MW3F4,MW3F7,MW3J1,MW3J4,MW3J5,MW3J6,MW3J7,MW3J8,MW3J9,MW3O4,MW3O5,MW3O6,MW3O7,MW3O8,MW3O9,MW3P4,MW3P5,MW3P6,MW3P7,MW3P8,MW3P9,MW4P4,MW4P5,MW4P6,MW4P7,MW4P8,MW4P9,MW5M4,MW5M5,MW5M6,MW5M7,MW5M8,MW5M9,MW5N4,MW5N5,MW5N6,MW5N7,MW5N8,MW5N9,NT5O1,NT5O2,NT5O3,NT5P1,NT5P2,NT5P3,NT6M1,NT6M2,NT6M3,NT6N1,NT6N2,NT6N3,NT6O1,NT6O2,NT6O3,NT6P1,NT6P2,NT6P3,NU2C4,NU2C5,NU2C6,NU2C7,NU2C8,NU2C9,NU2D4,NU2D7,NU2H1,NU2H4,NU2H5,NU2H6,NU2H7,NU2H8,NU2H9,NU3E4,NU3E7,NU3I1,NU3I4,NU3I5,NU3I6,NU3I7,NU3I8,NU3I9,NU3J4,NU3J5,NU3J6,NU3J7,NU3J8,NU3J9,NU3K4,NU3K5,NU3K6,NU3K7,NU3K8,NU3K9,NU3L4,NU3L5,NU3L6,NU3L7,NU3L8,NU3L9,NU7K1,NU7K2,NU7K3,NU7K5,NU7K6,NU7K7,NU7K8,NU7K9,NV4I1,NV4I2,NV4I3,NV4I4,NV4I7,NV4J1,NV4J2,NV4J3,NV4K1,NV4K2,NV4K3,NV4L1,NV4L2,NV4L3,NV4M1,NV4M4,NV4M7,NV5I1,NV5I2,NV5I3,NV5J1,NV5J2,NV5J3,NV5K1,NV5K2,NV5K3,NV5L1,NV5L2,NV5L3,NV7A1,NW1M4,NW1M5,NW1M6,NW1M7,NW1M8,NW1M9,NW1N4,NW1N5,NW1N6,NW1N7,NW1N8,NW1N9,NW1O4,NW1O5,NW1O6,NW1O7,NW1O8,NW1O9,NW1P4,NW1P5,NW1P6,NW1P7,NW1P8,NW1P9
Australia-wide	–	AR8, AR9, AS2, AS3, AS5, AS6, AS8, AS9, AT1, AT2, AT3, AT5, AT6, AT8, AT9, AU2, AU3, AU6, AU9, AV9, AW3, BR, BS, BT, BU, BV, BW1, BW2, BW3, BW5, BW6, CR, CS, CT, CU, CV, CW1, CW2, CW3, CW4, DQ, DR, DS, DT, DU, DV, DW1, DW2, DW3, EP, EQ, ER, ES, ET, EU, EV1, EV2, EV3, EV4, EV5, EV6, EV7, FP, FQ, FR, FS, FT, FU, FV1, FV2, FV3, FV4, FV5, GO3, GO4, GO5, GO6, GO7, GO8, GO9, GP, GQ, GR, GS, GT, GU, GV1, GV2, GV3, GV6, HO, HP, HQ, HR, HS, HT, HU, HV1, HV2, HV3, HV4, HV5, HV6, HV8, HV9, HW3, HW6, IO, IP, IQ, IR, IS, IT, IU, IV, IW, JO, JP, JQ, JR, JS, JT, JU, JV, JW, JX1, JX2, JX3, JX5, JX6, KO1, KO4, KO5, KO7, KO8, KP1, KP2, KP4, KP5, KP6, KP7, KP8, KP9, KQ, KR, KS, KT, KU, KV, KW, KX1, KX2, KX3, KX4, KX5, KX6, KX8, KX9, KY2, KY3, KY6, LP4, LP7, LQ1, LQ2, LQ4, LQ5, LQ7, LQ8, LR, LS, LT, LU, LV, LW, LX, LY, LZ1, LZ2, LZ3, MR1, MR4, MR5, MR7, MR8, MR9, MS, MT, MU, MV, MW, MX1, MX2, MX3, MX4, MX7, MY1, MY4, MY7, MZ1, NS4, NS7, NS8, NS9, NT, NU, NV1, NV2, NV3, NV4, NV5, NV7, NW1

Appendix 2: Spectral occupancy of incumbent services

Figures 12 to 19 show the current spectrum use of incumbent apparatus licensed services in the 3700–4200 MHz band in metropolitan, regional and remote areas (as defined in Appendix 1). The figures are based on RRL data from 1 May 2019.

Figure 12: Spectral occupancy in Adelaide

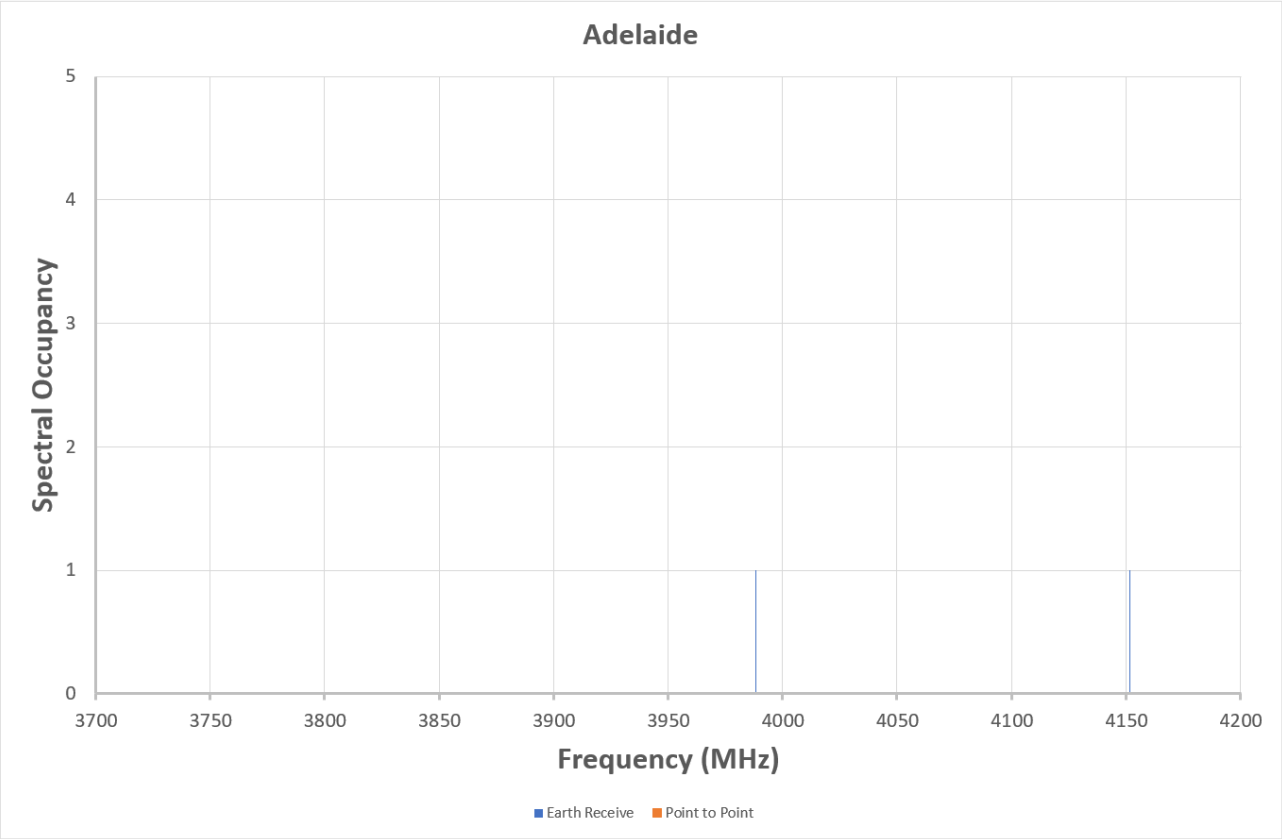


Figure 13: Spectral occupancy in Brisbane

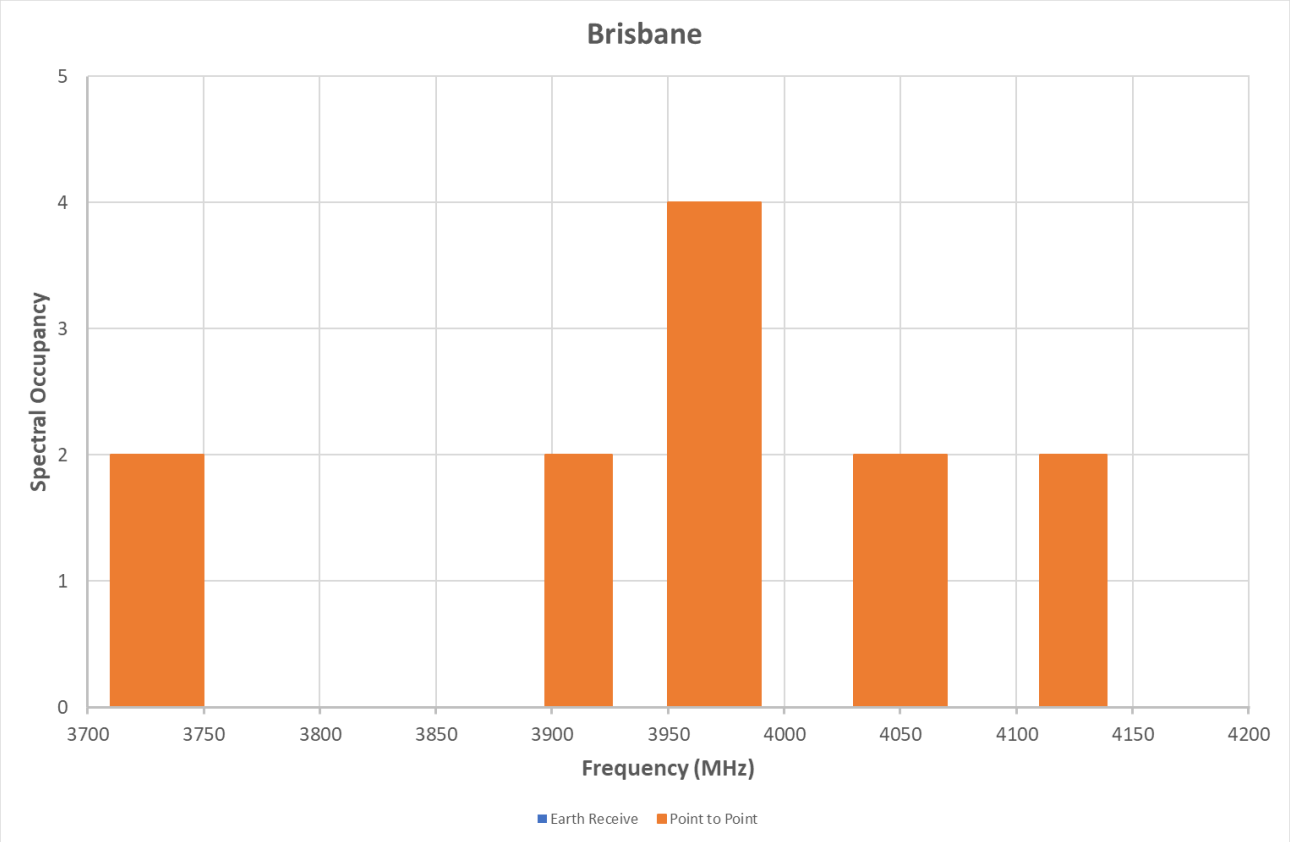


Figure 14: Spectral occupancy in Canberra

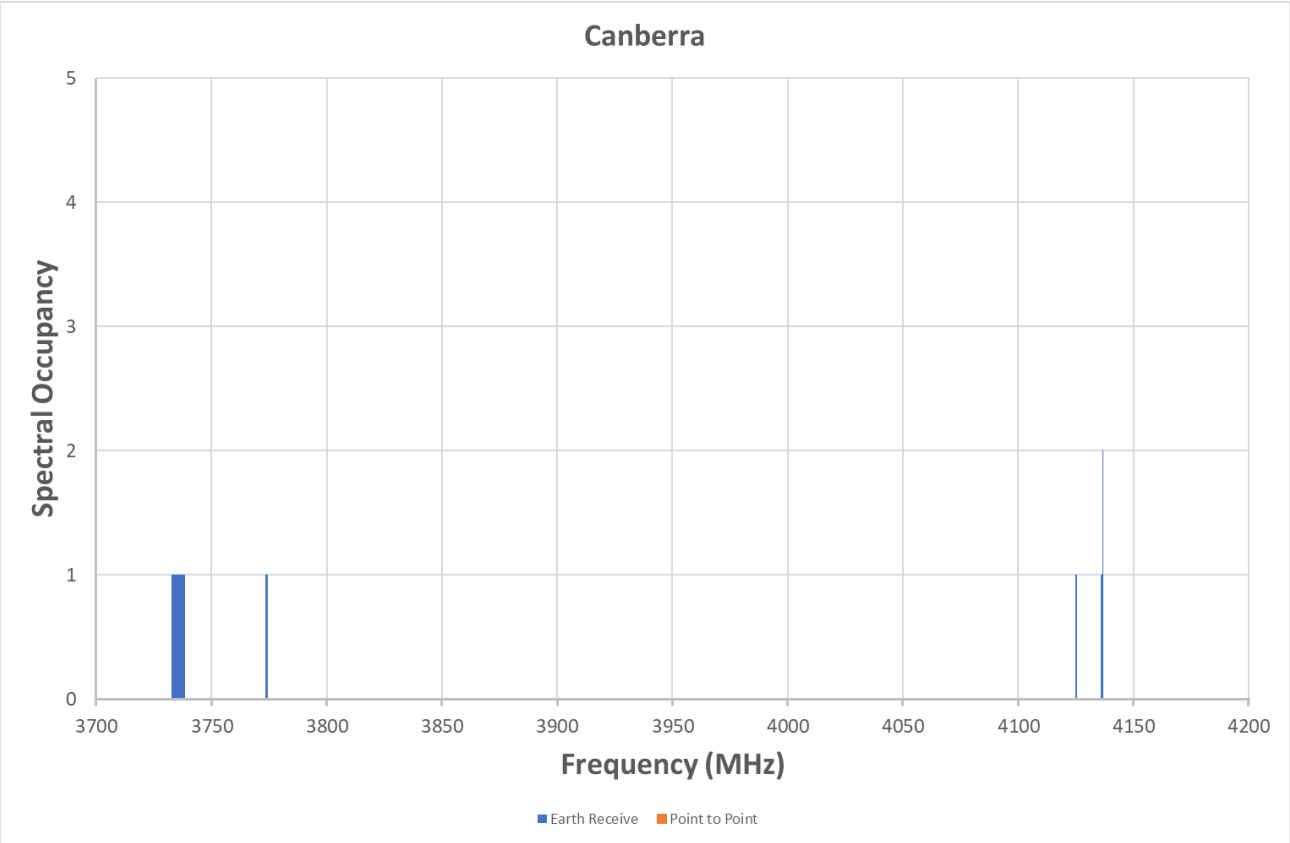


Figure 15: Spectral occupancy in Melbourne

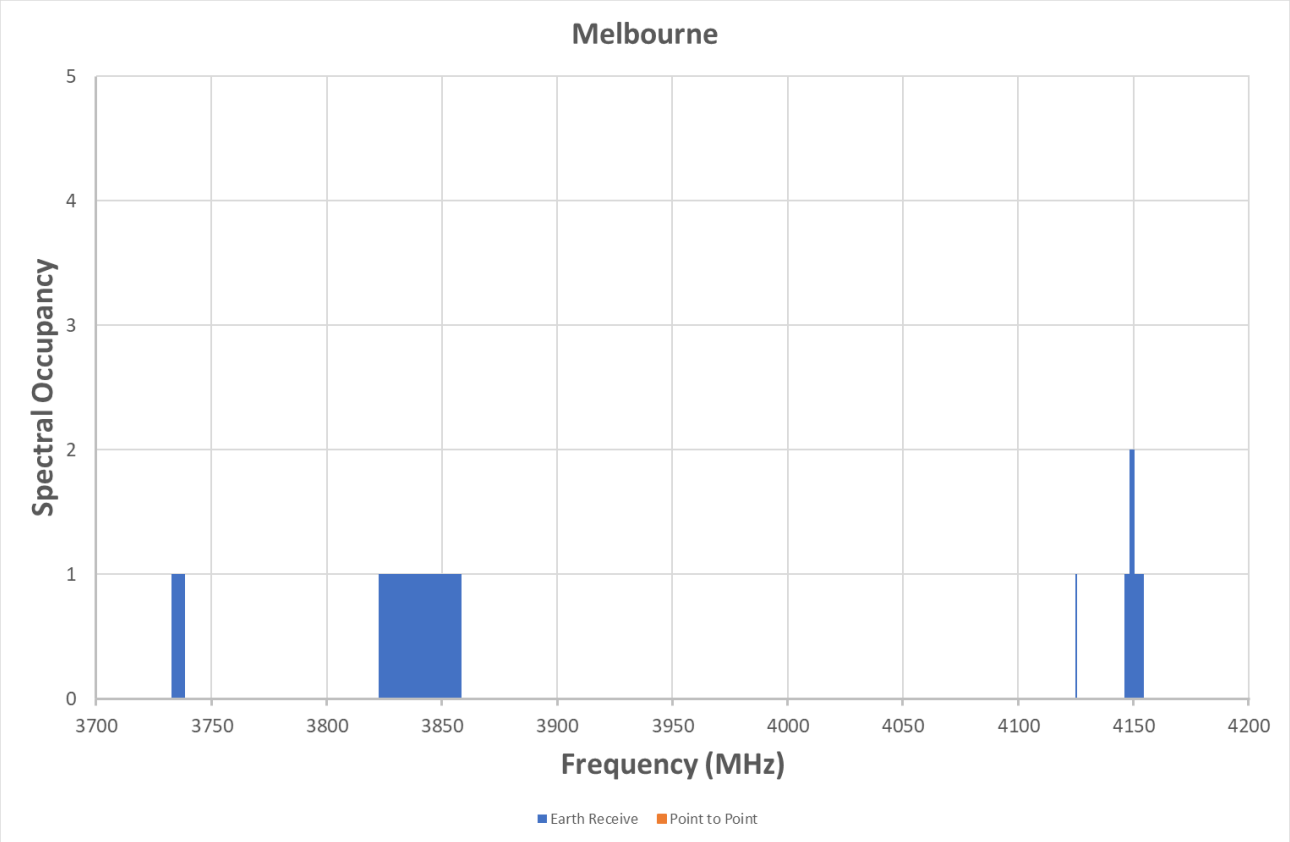


Figure 16: Spectral occupancy in Perth

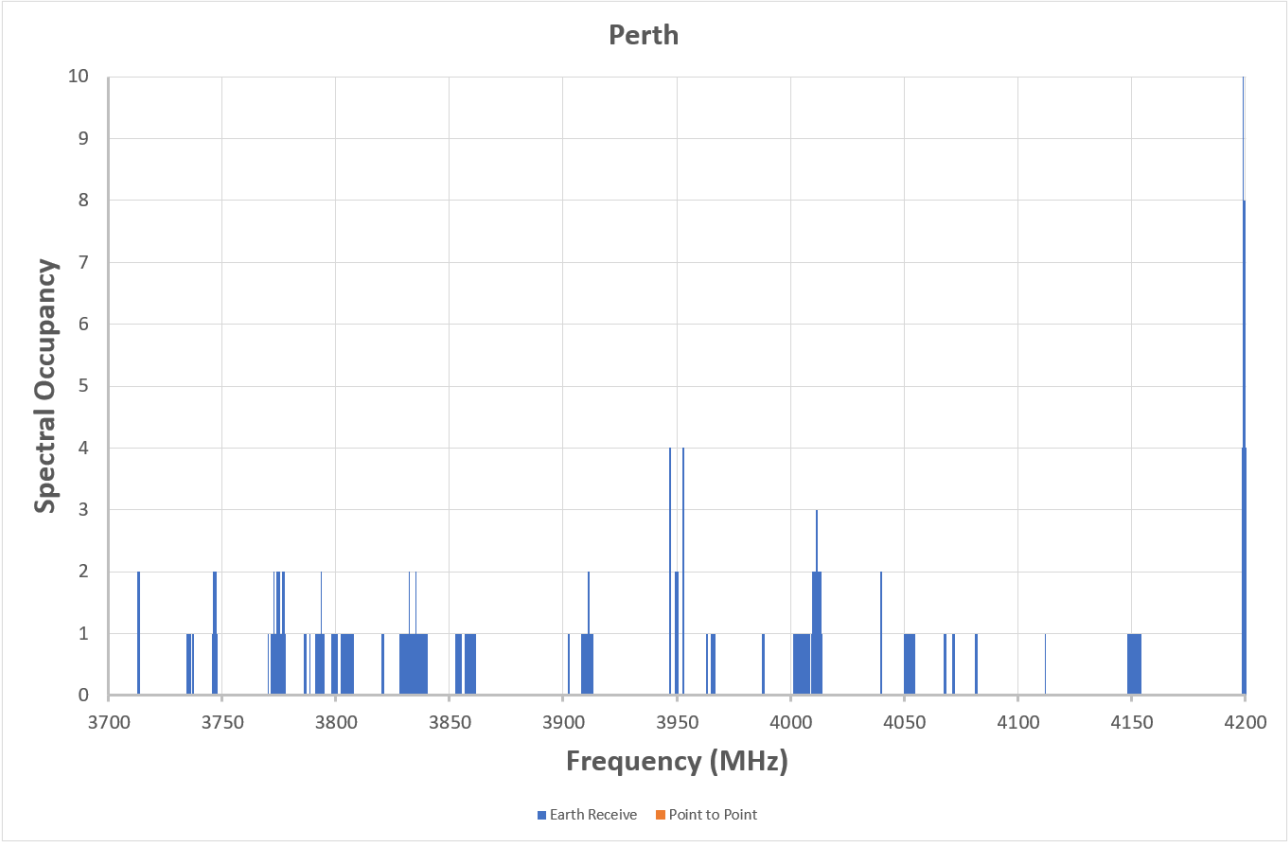


Figure 17: Spectral occupancy in Sydney

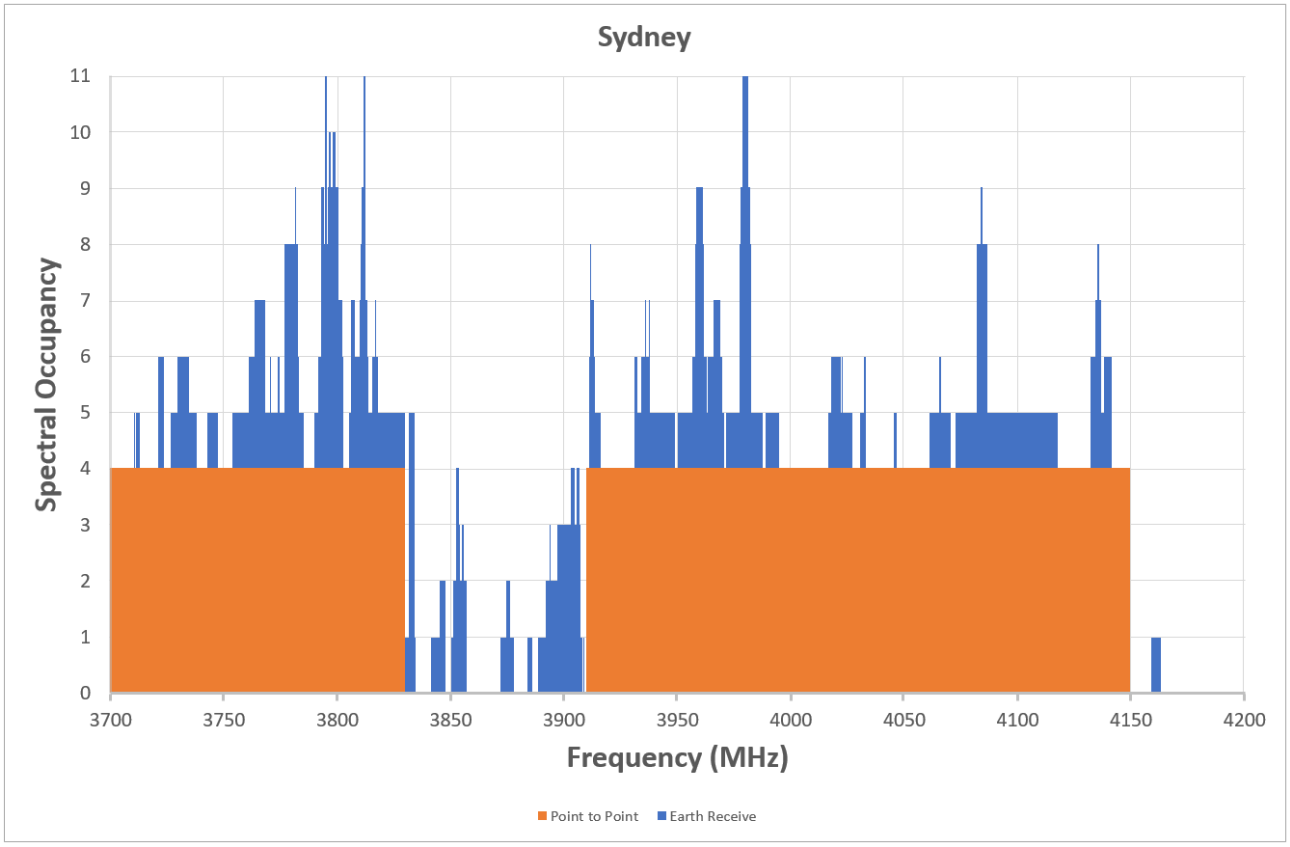


Figure 18: Spectral occupancy in regional areas

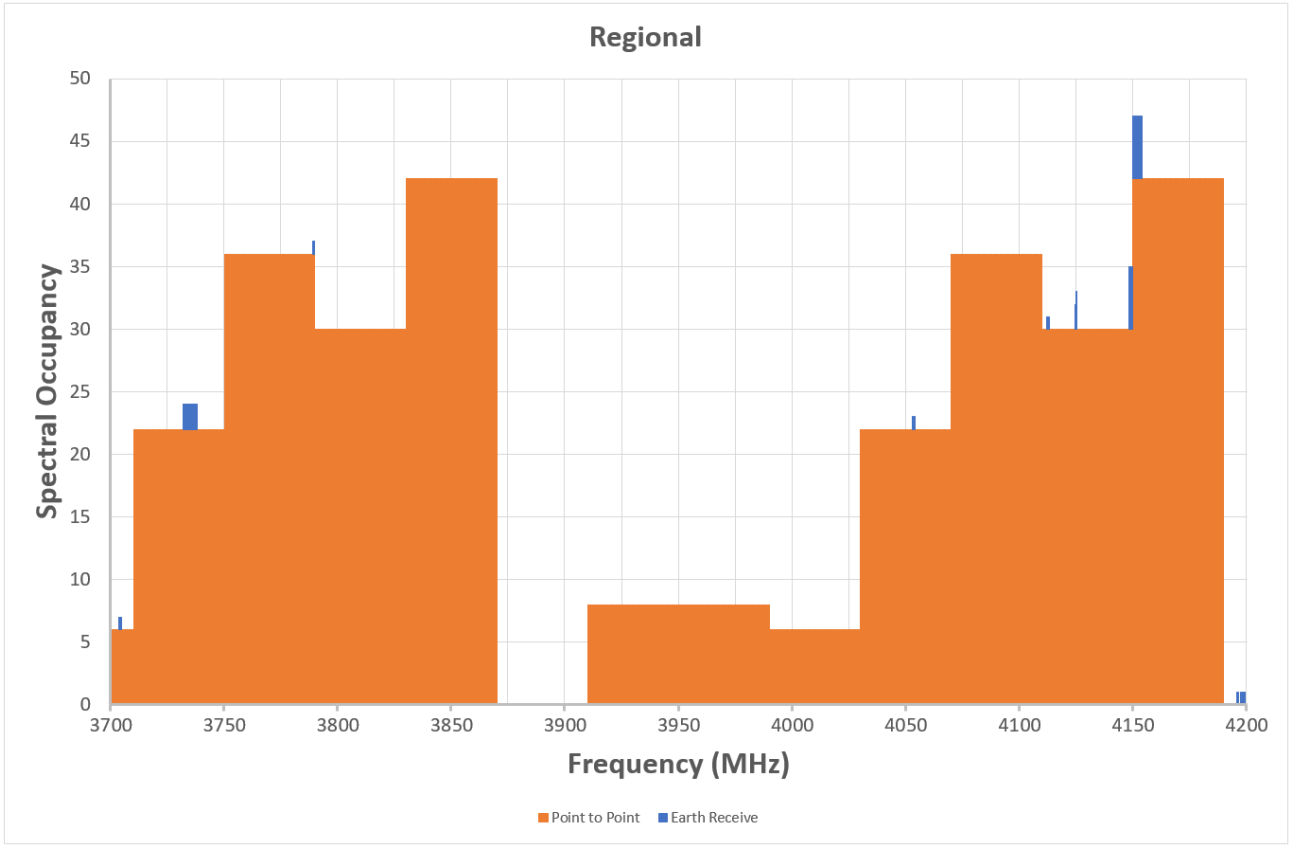
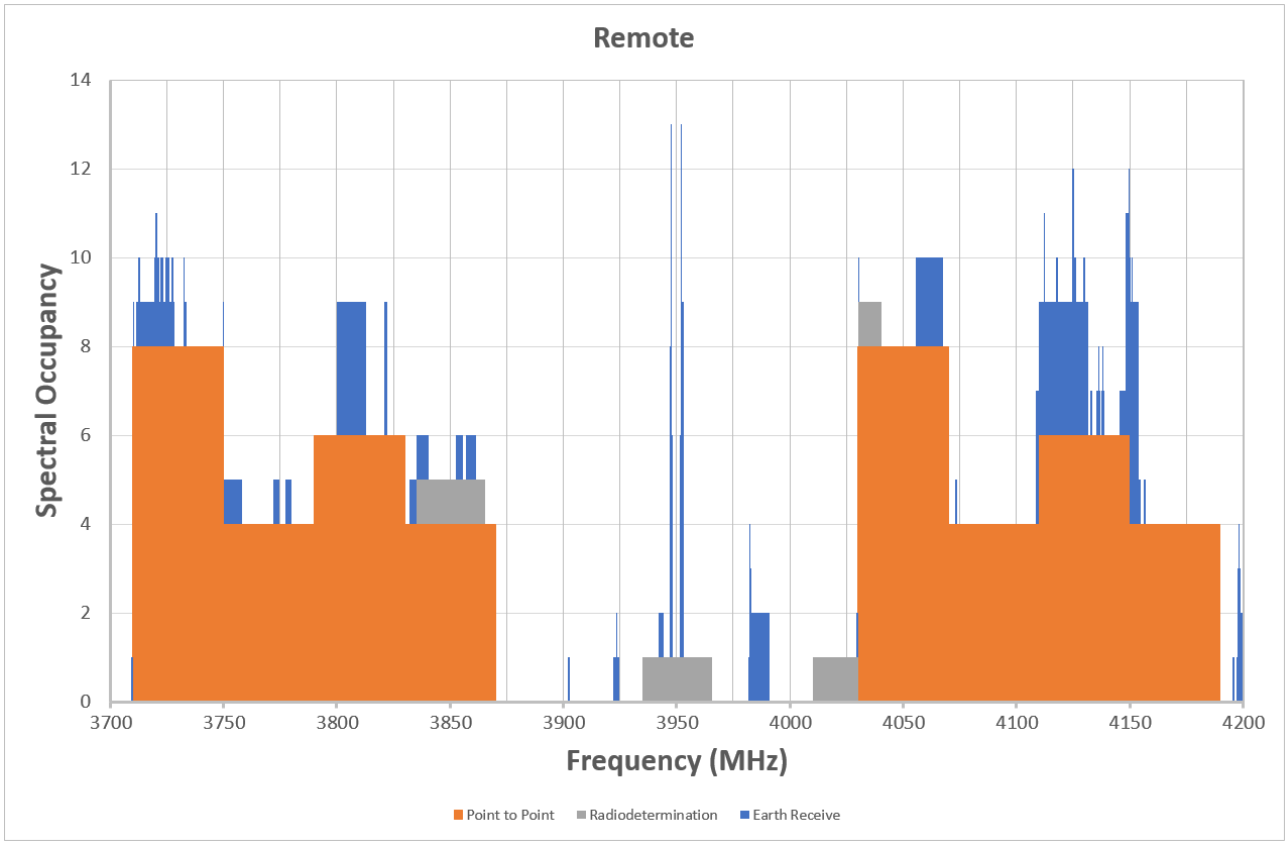


Figure 19: Spectrum occupancy in remote areas



Appendix 3: Synchronisation requirement

Each spectrum licence issued in the 3.6 GHz band will contain a 'synchronisation requirement' as a mandatory condition[39]. This condition is reproduced below.

Synchronisation requirement

If:

(a) interference occurs between:

  (i) a radiocommunications device (the ***first device***) operated under this licence; and

  (ii) a radiocommunications device (the ***other device***) operated under another spectrum licence or PTS transmitter licence in the relevant band and within the relevant area (the ***other licence***);

(b) the level of interference to the first device or to any other devices exceeds the compatibility requirement set out in the *Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers — 3.4 GHz Band) 2015* as in force from time to time;

(c) either the licensee or the holder (or authorised third party) of the other licence wishes to resolve the interference; and

(d) no agreement between the licensee and each person operating one or more other devices can be reached on how to manage the interference;

then the licensee is required to manage the interference by:

(e) either:

  (i) operating the first device with a frame structure that uses both uplink-downlink configuration 2 and special subframe configuration 6; or

  (ii) operating the first device using a sequence and duration of radio emissions that is consistent with those configurations (disregarding any time at which the device is not making a radio emission); and

(f) synchronising the timing of the frame structure or other sequence of radio emissions of the first device with the timing of the frame structure or other sequence of radio emissions of each of the other devices (disregarding any device at a time at which the device is not making a radio emission).

[39] A sample spectrum licence is available at Schedule 6 of the *Radiocommunications Spectrum Marketing Plan (3.6 GHz Band) 2018.*

Note 1: A licensee may act in accordance with sub-condition 11(e)(ii) by operating a transmitter in a manner that complies with the specification made by 3rd Generation Partnership Project numbered 3GPP TS 38.211 and published at www.3gpp.org

Note 2: The synchronisation requirement only applies when an interference issue occurs and where there is no other measure agreed to between the licensees to resolve the interference. This means synchronisation can be done on a site/cell specific basis. During any period in which the licensee and other licensee are taking steps to resolve the interference issue or synchronise, the ACMA will generally give priority to the device registered first in time in any interference dispute, meaning that device or devices registered later-in-time will generally be required to accept any interference or cease causing interference during this time.