Planning for wireless broadband use in urban areas in the 3400–3475 MHz band

Options paper

september 2021

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Executive summary

In November 2019, the Australian Communications and Media Authority (ACMA) released the [*Optimising arrangements for the 3400–3575 MHz band – Planning decisions and preliminary views*](https://www.acma.gov.au/consultations/2019-08/optimising-3400-3575-mhz-band-consultation-122019) outcomes paper.It outlined our plans to defragment apparatus licence arrangements and spectrum licence holdings in the 3400–3575 MHz band. Since releasing the paper, we have been working to implement the planning outcomes.

Key announcements in the outcomes paper relevant to this options paper include:

An intention to vary [*Radiocommunications assignment and licensing instruction MS44 – Frequency coordination procedures for the earth station protection zones*](https://www.acma.gov.au/publications/2019-08/instruction/frequency-coordination-procedures-earth-station-protection-zones)(RALI MS44) so that earth station protection zones (ESPZs) in eastern Australia cover those parts of the band not subject to spectrum licensing.

Plans to convert NBN Co’s apparatus licences in the 3400–3575 MHz band to spectrum licences. This will facilitate spectrum licensees in the 3400–3575 MHz band to defragment their spectrum holdings in most areas (‘defrag’).

We would work with NBN Co to surrender any licences it holds in urban areas that it does not plan to provide terrestrial wireless broadband services. This is referred to as ‘urban excise’. The associated urban excise areas are defined in [Appendix A](#_Appendix_A:_Urban). The ACMA also committed to working with industry to investigate ways to make this spectrum available for use by other wireless broadband operators.

We consider there is a clear case for action to implement consequential changes to the 3.4 GHz spectrum licence technical framework to support the NBN licence conversion process and band defragmentation. We also consider there is still a case to investigate ways to make urban excise areas available for use by wireless broadband operators other than NBN Co. In combination with the work to implement these outcomes, the ACMA has taken the opportunity to consider general updates to the [Radiocommunications (Unacceptable Levels of Interference – 3.4 GHz Band) Determination 2015](https://www.legislation.gov.au/Series/F2015L00727)(the s.145(4) Determination) that are progressively being made to similar instruments in other spectrum licence bands. We will also consider aligning receiver spurious emission limits with international standards.

The ACMA has developed proposed amendments to the 3.4 GHz spectrum licence technical framework and options for use of urban excise areas. This paper seeks comment on those proposed amendments and options. Feedback received will help inform our decision making.

## Proposed amendments to the 3.4 GHz technical framework

This paper proposes changes to the following aspects of the 3.4 GHz spectrum licence technical framework:

**The s.145(4) Determination:** This includes general changes to align with those identified and implemented in the review of the [2.3 GHz technical framework](https://www.acma.gov.au/consultations/2020-12/review-23-ghz-spectrum-licencing-technical-framework-consultation-372020). These will enable spectrum licensees to deploy services closer to the geographical boundaries of their licence, subsequently increasing the utility of the spectrum. An additional change is also proposed to ensure NBN Co can re-register devices that were retuned as part of the defrag process. It is intended that this additional change be a temporary measure until formal arrangements for urban excise areas are finalised and implemented.

**The core condition related to receiver spurious emission limits:** It is proposed to modify the limits to align with 3rd Generation Partnership Project (3GPP) technical specifications. This would allow licensees to tap into global economies of scale for equipment.

**RALI MS44:** It is proposed to include parts of the 3400–3575 MHz band not subject to spectrum licensing, to the list of frequencies offered protection at existing ESPZs in eastern Australia as well as the Uralla earth station facility.

The changes proposed to the 3.4 GHz spectrum licence technical framework can be implemented independently of arrangements for use of spectrum in the urban excise areas. Informed by feedback received on these issues, the ACMA aims to implement any changes in the fourth quarter of 2021.

## Options for use of spectrum in urban excise areas

Four options have been identified for use of spectrum in urban excise areas. These are shown in Figure 1, with more detail provided in Table 7 of this paper. Each option involves a different combination of:

macro-cell[[1]](#footnote-2) or restricted cell[[2]](#footnote-3) deployment models

support for single or multiple operators per channel in an urban excise area.

1. Pictorial description of options for urban excise use[[3]](#footnote-4)

Graphical user interface, text, application, email

Description automatically generated

To assist with assessing each option, we identified 4 desirable planning outcomes for making spectrum in urban excise areas available for wireless broadband. These are:

Provide adequate protection to incumbent NBN Co services in adjacent areas.

Ensure NBN Co is not unreasonably constrained in its ability to deploy new and more spectrally efficient technologies in the future (e.g., moving from 4G to 5G technologies).

Minimise the impact any new arrangements may have on existing 3.4 GHz spectrum licences above 3475 MHz.

Maximise the utility of spectrum in urban excise areas for new wireless broadband services.

After considering the assessment of each option against its desirable planning outcomes, the ACMA has identified Option 4 as its preliminary preferred option for use of spectrum in the urban excise areas. We consider Option 4 best promotes the long‑term public interest derived from use of the 3400–3475 MHz band. Key points that support this conclusion are:

It provides the greatest technical flexibility for how operators can use urban excise areas. This includes support for both macro and restricted cell deployments.

It minimises spectrum incorporated into restricted use bands.

It is expected to result in greater spectrum utility in the 3460–3475 MHz frequency range.

In a given area, multiple operators could be supported by licensing them in different segments of the 3400–3475 MHz frequency range

Once a decision has been made on adoption of an option, we will implement that outcome. This includes finalising interference management criteria, developing RALIs and making/updating relevant legislative instruments. Where it makes sense to do so, it is proposed any work will be combined with similar work being conducted to implement the [*Replanning the 3700–4200 MHz band – Outcomes paper*](https://www.acma.gov.au/consultations/2020-07/planning-options-3700-4200-mhz-band-consultation-222020).

# Issues for comment

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

Comment is sought on the draft amendments to the s.145(4) Determination contained at Appendix B, found as a separate attachment in the key documents section of this consultation.

Should additional measures be included to grandfather device registrations when minor modifications are made?

If so, what minor modifications should be permitted? For example, changes that results in the same or lower horizontal radiated power for the purposes of device boundary calculations. Alternatively, changes that result in the same or smaller device boundary as originally calculated when registering a device.

1. Comment is sought on the proposed changes to receiver spurious emission limits on 3.4 GHz spectrum licences.

Comment is sought on the draft amendments to RALI MS44 contained in Appendix C, found as a separate attachment in the key documents section of this consultation.

Comment is sought on the options developed for use of spectrum in urban excise areas.

Comment is sought on the desirable planning outcomes for use of spectrum in urban excise areas

Views are sought on the possible interference management approaches for both co-channel mechanisms (including ducting) and adjacent channel mechanisms (including adjacent band coexistence) contained at [Appendix E](#_Appendix_E:_Possible).

1. Comment is sought on the ACMA’s preliminary preferred option. Are other options proposed, and if so, why?

# Introduction

## Purpose of this paper

In November 2019, the Australian Communications and Media Authority (ACMA) released the [*Optimising arrangements for the 3400–3575 MHz band – Planning decisions and preliminary views*](https://www.acma.gov.au/consultations/2019-08/optimising-3400-3575-mhz-band-consultation-122019) outcomes paper.It outlined our plans to defragment apparatus licence arrangements and spectrum licence holdings in the 3400–3575 MHz band. Since releasing the paper, we have been working to implement the planning outcomes.

Key announcements in the outcomes paper relevant to this options paper include:

An intention to vary [*Radiocommunications assignment and licensing instruction MS44 – Frequency coordination procedures for the earth station protection zones*](https://www.acma.gov.au/publications/2019-08/instruction/frequency-coordination-procedures-earth-station-protection-zones)(RALI MS44) so that earth station protection zones (ESPZs) in eastern Australia cover those parts of the band not subject to spectrum licensing.

Plans to convert NBN Co’s apparatus licences in the 3400–3575 MHz band to spectrum licences. This will facilitate spectrum licensees in the 3400–3575 MHz band to defragment their spectrum holdings in most areas (‘defrag’).

The ACMA working with NBN Co to surrender any licences it holds in urban areas that it does not plan to provide terrestrial wireless broadband services. This is referred to as ‘urban excise’. The associated urban excise areas are defined in [Appendix A](#_Appendix_A:_Urban). We are committed to working with industry to investigate ways to make this spectrum available for use by other wireless broadband operators.

The ACMA convened the 3.4 GHz technical liaison group (TLG)[[4]](#footnote-5) to review the [3.4 GHz spectrum licence technical framework](https://www.acma.gov.au/34-ghz-technical-framework) and provide advice on options for spectrum use inf urban excise areas. We used this TLG to review several other aspects of the 3.4 GHz spectrum licence technical framework necessary to support the expansion of spectrum licence arrangements in the band. This included a review of the [Radiocommunications (Unacceptable Levels of Interference – 3.4 GHz Band) Determination 2015](https://www.legislation.gov.au/Series/F2015L00727" \t "_self)(the s.145(4) Determination) and the spectrum licence core condition relating to receiver spurious emission limits. The intention was to consider general updates to the s.145(4) Determination that are progressively being made to similar instrument in other spectrum licence bands, as well as to consider aligning receiver spurious emission limits with international standards.

We have developed proposed amendments to the 3.4 GHz spectrum licence technical framework and options for use of urban excise areas. The purpose of this paper is to seek comment on those proposed amendments and options.

## Legislative and policy environment

Managing spectrum efficiently and effectively for the benefit of all Australians is a key priority for the ACMA.[[5]](#footnote-6)

### Guiding legislation and policy

The ACMA’s decisions are guided by the object of the [*Radiocommunications Act 1992*](https://www.legislation.gov.au/Details/C2019C00262) (the Act) to promote the long‑term public interest derived from the use of the spectrum by providing for the management of the spectrum in a manner that:

1. facilitates the efficient planning, allocation and use of the spectrum
2. facilitates the use of the spectrum for:
   1. commercial purposes
   2. defence purposes, national security purposes and other non‑commercial purposes (including public safety and community purposes)
3. supports the communications policy objectives of the Commonwealth Government.

On 10 December 2020, the Minister for Communications, Cyber Safety and the Arts, the Hon Paul Fletcher MP, made a notice designating parts of the 3.4 GHz band for spectrum licensing.[[6]](#footnote-7) The areas and frequencies covered by the notice encompass apparatus licences held by NBN Co. The notice has allowed the ACMA to convert NBN Co’s apparatus licences to spectrum licences, facilitating defragmentation of the 3.4 GHz band. NBN Co uses this spectrum to provide fixed-wireless services in regional and outer-metropolitan areas. The Explanatory Statement to the Minister’s designation notice noted the government’s expectation that ‘ACMA will work with NBN Co to make underutilised spectrum in inner-metropolitan areas of NBN Co’s spectrum licences available for licensing by other operators, subject to the development of appropriate interference management criteria and assessment of the utility of the spectrum’.

Several communications policy objectives relevant to the replanning considerations in this band have been identified.

The government’s [*Digital Economy Strategy*](https://digitaleconomy.pmc.gov.au/sites/default/files/2021-07/digital-economy-strategy.pdf) *2030*, released in 2021, sets out how Australia will secure its future as a modern and leading digital economy and society by 2030. The strategy identified that digital infrastructure was a key enabler making it possible to access the digital world. The strategy noted that the government is supporting the roll out of 5G services through the timely availability of spectrum, streamlining deployment arrangements and showcasing trials of 5G use cases to promote business uptake.

The [5G—Enabling the future economy](https://www.communications.gov.au/departmental-news/5g-enabling-future-economy) strategy, released in 2017, committed to government action to support the timely rollout of 5G in Australia, including making spectrum available in a timely manner.

[Australia’s Tech Future](https://www.industry.gov.au/news-media/australias-tech-future), released in December 2018, sets out the Australian Government’s strategy for the nation’s technological future. The strategy presents a vision that Australians have access to world-class digital infrastructure in their personal and working lives with the following outcomes:

Australians have reliable, secure and affordable access to high-speed broadband and mobile communications.

Australia’s communications sector is sustainable and competitive.

Australia’s world-leading navigation and positioning infrastructure supports emerging technologies.

Australia’s researchers have the specialised high-performing computing and data infrastructure needed to stay ahead in everything from health to agriculture.

### Other relevant advice

We note the [Australian Government’s response](https://www.infrastructure.gov.au/department/ips/government_responses/government-response-next-gen-future.aspx) of November 2020 to the parliamentary report [*Next Gen Future: Inquiry into the deployment, adoption and application of 5G in Australia*](https://www.aph.gov.au/Parliamentary_Business/Committees/House/Communications/5G/Report). In particular, we acknowledge the government’s support for Recommendation 1 of the report, which recommended the ACMA finalise spectrum allocations expeditiously and investigate how future spectrum auctions can promote improved market competition for the benefit of consumers.

### Licensing arrangements

There are currently 3 licence types available to authorise access to spectrum –spectrum, apparatus and class licences. Each of these have differing characteristics with respect to the allocation method commonly used, approach to pricing, associated level of exclusivity and interference environment. These approaches influence how options can be developed and implemented.

On 17 June 2021, amendments to the Actfrom the *Radiocommunications Legislation Amendment (Reform and Modernisation) Act 2020* (the Modernisation Act) came into force. The amendments allow for greater flexibility for the ACMA to manage spectrum and greater clarity to licensees. More information on the amendments can be found on the [ACMA website](https://www.acma.gov.au/radcomms-licensing-and-allocation-reform). The ACMA has developed an [overview of its approach](https://www.acma.gov.au/publications/2021-03/rules/our-approach-radcomms-licensing-and-allocation) to implementing the changes to licensing and allocation.

A spectrum licence authorises the operation of devices within a defined frequency range and geographic area, with a high degree of exclusivity. The geographic area can vary in size and can comprise the entire country. Spectrum licences are usually allocated by an auction and have historically been utilised for most bands used to deploy commercial mobile broadband networks. Spectrum licences may be allocated for up to 20 years.

An inherent feature of spectrum licensing is technological flexibility – that is, the licence conditions and associated technical framework, while usually optimised for an expected technology, specify generic technical conditions[[7]](#footnote-8) and do not usually expressly mandate or limit specific technologies or services. This allows a licensee to deploy any technology that complies with the conditions of the licence. It is up to the licensee to manage interference between their devices (note that the adoption of international standards within the technical framework mitigates the potential for interference between devices). Spectrum licences are more conducive to secondary trading than apparatus licences, due to design features such as their longer tenure and their ability to be sub-divided.

An apparatus licence authorises the use of a radiocommunications device (or group of devices) operating under a specific radiocommunications service type, in a specific frequency range, and traditionally at one or more specific geographic locations for a period of up to 20 years. They are typically issued ‘over-the-counter’ in accordance with coordination policies developed by the ACMA. We [impose cost recovery](https://www.acma.gov.au/fees-apparatus-licences) charges, and separate legislation imposes taxes in relation to apparatus licences. These amounts cover our costs and give people incentive to use spectrum efficiently.

The ACMA has also created a new apparatus licence type – the [area-wide apparatus licence](https://www.acma.gov.au/area-wide-apparatus-licence). This authorises the operation of one or more radiocommunications devices within a defined geographic area within frequencies specified in the licence, subject to the conditions included on the issued licence. The licence type is proposed to be scalable, enabling its use for authorising different-sized geographic areas and bandwidths. Unlike existing apparatus licence types – which typically align with specific uses and purposes – the area-wide apparatus licence is capable of authorising a variety of services, uses, applications and technologies.

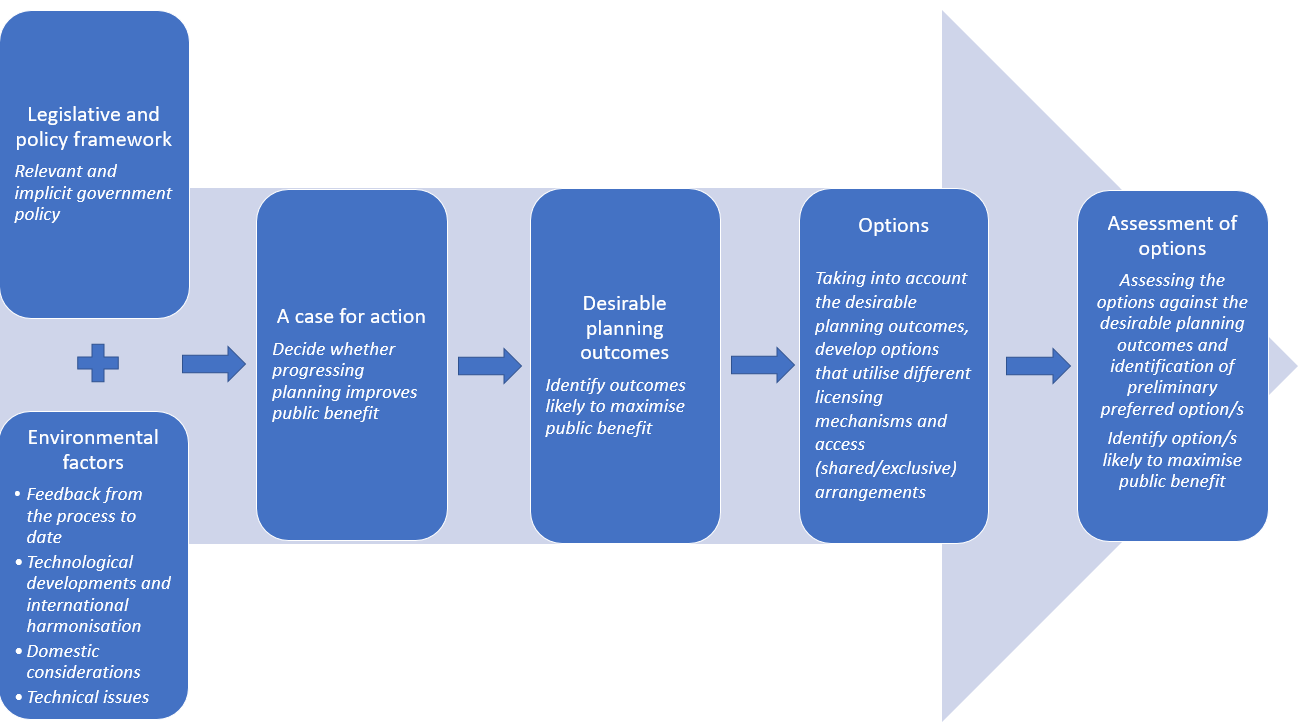
Class licences are a standing authorisation to access spectrum without the need to apply to the ACMA for an individual licence (hence taxes or charges are paid), subject to the conditions of the relevant class licence. These conditions include technical and geographic matters and/or pertain to the type of use or class of user.

### Spectrum planning options development

We are guided in our spectrum management functions by the object of the Act, set out in [Guiding legislation and policy](#_Guiding_legislation_and). A balanced application of regulatory and market mechanisms is often necessary in order to achieve key elements of the object of the Act, in particular maximising the overall public benefit from the efficient allocation and use of the radiofrequency spectrum and meeting the government’s policy objectives.

Figure 2 describes the approach the ACMA has used in acquiring and assessing preliminary replanning options for the use of urban excise areas in the 3400–3475 MHz band. The ACMA will continue to apply this general approach as it considers the responses to this paper and decides on the outcomes.

1. Spectrum planning options framework



## 3.4 GHz technical liaison group

From October 2020 to July 2021, the ACMA [convened a TLG](https://www.acma.gov.au/spectrum-licence-technical-liaison-groups) (a short-term advisory body) to review the 3.4 GHz spectrum licence technical framework and develop options for use of spectrum in urban excise areas. While not having any decision-making powers, it provides advice on the development of, or possible changes to, a spectrum or apparatus licence technical framework. Membership included 3.4 GHz spectrum licensees, the Department of Defence, equipment manufacturers, the Australian Mobile Telecommunications Association (AMTA), the Global Systems for Mobile Communications Association (GSMA), amateurs, Boeing, Department of Infrastructure, Transport, Regional Development and Communications (DITRDC) and Inmarsat.

The scope of the TLG was to consider the following issues:

Consequential changes to the [3.4 GHz band technical framework](https://www.acma.gov.au/34-ghz-technical-framework) required to support the conversion of NBN Co’s existing apparatus licences to spectrum licences (referred to as consequential changes).

Development of options for use of spectrum in urban excise areas by wireless broadband services. This included development of suitable interference management criteria.

Review of the s.145(4) Determination.

Review the receiver spurious emission limits contained as a core condition in 3.4 GHz spectrum licences.

Review text in the [Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers — 3.4 GHz Band) 2015](https://www.legislation.gov.au/Series/F2015L00729)   
(the RAG Rx) relating to interference management with Department of Defence radar systems. The aim of this was to provide greater guidance on the issue.

The outcomes of the TLG are contained in the [*Review of the 3.4 GHz spectrum licence technical framework Technical Liaison Group paper*](https://www.acma.gov.au/spectrum-licence-technical-liaison-groups) (3.4 GHz TLG paper).

It is noted that:

Not all issues considered by the TLG are within the scope of this options paper.

A TLG is the first step in the process of reviewing a technical framework. The ACMA will consider the outcomes of a TLG before consulting on changes to the relevant instruments that form the 3.4 GHz band technical framework. This means TLG members are able to provide comments on the technical framework both as part of the informal TLG and subsequent formal public consultation processes.

While we strive to achieve consensus with TLG members, the final decision on the content of, or changes to, a spectrum or apparatus licensing technical framework rests with the ACMA. This is particularly relevant in cases where consensus cannot be achieved on an issue or advice from the TLG is not provided.

## Scope of this paper

This consultation paper focuses on:

Amendments to RALI MS44.

Amendments to the s.145(4) Determination.

Updates to the 3.4 GHz spectrum licence core condition related to spurious emission limits.

Considering options for use of urban excise areas for the delivery of wireless broadband services.

The following issues are outside the scope of this paper:

Issues being considered by the 3400–4000 MHz TLG. This includes implementation of the [*Replanning the 3700–4200 MHz band: Outcomes paper*](https://www.acma.gov.au/consultations/2020-07/planning-options-3700-4200-mhz-band-consultation-222020), as well as the development of arrangements for wireless broadband systems in regional and remote areas of the 3400–3575 MHz band.

The following issues considered by the 3.4 GHz band TLG:

The consequential changes identified for 3.4 GHz spectrum licences. These are only critical for licences that will operate in spectrum included in the [*Radiocommunications (Spectrum Designation—3.4 GHz Band) Notice 2020*](https://www.legislation.gov.au/Details/F2020L01661). These changes are being made to relevant licences as part of the defrag process. The relevant conditions on other licences will be incorporated the next time 3.4 GHz spectrum licences are varied.

The consequential changes identified for the [Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015](https://www.legislation.gov.au/Series/F2015L00728) (the RAG Tx) and the RAG Rx. These are not critical to make now. To avoid multiple consultations reviewing these guidelines, the changes will be consulted on at the same time as amendments to support the broader 3400–4000 MHz frequency range.

Review of text in the RAG Rx relating to interference management with defence radar systems. The ACMA does not consider any changes to the RAG Rx are required at this time.

## Next steps

An indicative timeline for the completion of work identified in this paper is shown in Table 1.

The dates in this timeline may change considering the feedback provided by stakeholders to this paper and other ACMA priorities. Pending final decisions on planning outcomes, the allocation of spectrum in urban excise areas may also be linked with the allocation of apparatus or spectrum licences in the 3400–4000 MHz band. Our [Five-year spectrum outlook](https://www.acma.gov.au/five-year-spectrum-outlook) provides an estimate for the allocation of this spectrum based on current priorities.

Indicative timetable for finalising work

|  |  |  |
| --- | --- | --- |
| Step | Step detail | Completion date |
| Public consultation | Consult on options for use of spectrum in urban excise areas and updates to the s.145(4) Determination, receiver spurious emission limits and RALI MS44. | August 2021 |
| Finalise technical framework changes | Pending a review of feedback to the consultation paper, implement changes to the s.145(4) Determination, receiver spurious emission limits and RALI MS44. | October/November 2021 |
| Consult on final regulatory arrangements for spectrum use in urban excise areas | Following the ACMA decision on what option to implement, we will formally consult on regulatory arrangements necessary to enable access to spectrum in urban excise areas. Where it makes sense to do so, we will combine any such consultation with that necessary for implementing arrangements in the 3400–4000 MHz band. | Earliest: Q4 2021 |
| Release of spectrum | Timeframes depend on the option implemented, licence type used, and allocation method adopted. Any outcome that uses AWLs or spectrum licences is proposed to be combined with allocation processes for spectrum in the 3700–4000 MHz band. | Q2 2022 to Q2 2023 |

# Case for action

The ACMA considers giving effect to defragmentation of the band and investigating options for use of spectrum in urban excise is consistent with spectrum management outcomes that will contribute to the long-term public benefit. This is in large part due to the continued benefits derived from both using existing licensed spectrum more efficiently (through technical framework changes) and exploring options for use of currently unused spectrum in urban excise areas are both consistent with the continuing demand for spectrum supporting wireless broadband, specifically 5G, opportunities.

The 3.4 GHz band continues to form a part of key 5G profile bands defined by   
3rd Generation Partnership Project (3GPP) technical specifications for wireless broadband uses. This includes the n77 (3300–4200 MHz) and n78 (3300–3800 MHz) bands, which have the fourth and first-largest 5G equipment ecosystems available globally for operators.[[8]](#footnote-9) Access to spectrum in these bands to deliver wireless broadband services is sought domestically, particularly in urban and suburban environments of capital cities.[[9]](#footnote-10)

NBN Co has indicated it does not intend to deploy services under its current licences in the 3.4 GHz band within urban and surrounding suburban areas of Adelaide, Brisbane, Canberra, Melbourne, Perth and Sydney. Consequently, there has been interest from other wireless broadband operators in accessing these areas to deploy services.[[10]](#footnote-11)

Accordingly, the ACMA considers there is a clear case for action to implement consequential changes to the 3.4 GHz spectrum licence technical framework to support the NBN conversion process/band defragmentation and to investigate ways of making spectrum in urban excise areas available for use by wireless broadband operators other than NBN Co.

# Proposed amendments to the 3.4 GHz technical framework

This section of the paper proposes changes to the 3.4 GHz band spectrum licence technical framework. An assessment is also provided on the effect the proposed changes may have on services within, and adjacent to, the 3.4 GHz band.

As detailed in the scope of this paper, only changes to RALI MS44, the s.145(4) Determination and the core condition relating to receiver spurious emission limits are considered in this paper.

## Overview of the 3.4 GHz spectrum licence technical framework

A spectrum licence technical framework consists of 3 interlocking regulatory elements provided for under the Act:

The conditions specified in the spectrum licence – in particular, the core conditions that define the spectrum space (both frequency and geographical area) and the level of emissions permitted inside and across the frequency boundaries of the licence (section 66 of the Act). Section 71 also provides for the ACMA to include other conditions in a spectrum licence.

A determination of unacceptable interference for the purpose of device registration in each band (section 145 of the Act), referred to as a s.145(4) Determination. Under a spectrum licence, a radiocommunications device must not be used unless it is registered on the Register of Radiocommunications Licences (the RRL) or exempt from registration. The ACMA may refuse to register a device if it is satisfied it would cause an unacceptable level of interference. A determination under section 145 defines what is an unacceptable level of interference by reference to levels of emissions across geographical licence boundaries, and also by reference to various deployment constraints.

Radiocommunications advisory guidelines (RAG) provide assistance and advice for coordination with stations providing other services when and where required (section 262 of the Act). This includes detailing interference management criteria with incumbent apparatus licences and other spectrum licences.

A more comprehensive explanation of spectrum licence technical frameworks is provided in the document [*Spectrum licensees – know your obligations*](https://www.acma.gov.au/publications/2012-12/guide/spectrum-licencees-know-your-obligations).

The elements that comprise the current 3.4 GHz technical framework are:

* Spectrum licence ([current licence holders and copies of licences](https://web.acma.gov.au/rrl/browse_licences.licence_list?pSV_ID=85&pSS_ID=861)).
* [Radiocommunications (Unacceptable Levels of Interference – 3.4 GHz Band) Determination 2015](https://www.legislation.gov.au/Series/F2015L00727) (the s.145(4) Determination).
* [Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015](https://www.legislation.gov.au/Series/F2015L00728) (the RAG Tx).
* [Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers – 3.4 GHz Band) 2015](https://www.legislation.gov.au/Series/F2015L00729) (the RAG Rx).

## s.145(4) Determination

A s.145(4) Determination sets out the circumstances in which devices are taken to cause unacceptable levels of interference, for the purposes of section 145 of the Act. These circumstances typically include if the:

Levels of emissions from a device at the geographical boundary of a licence exceed a defined level as determined by the device boundary criteria (DBC).

Operation of the transmitter will cause a breach of a core condition of the licence.

Deployment of the device is outside any deployment constraints defined for the relevant band.

If a device meets these requirements, it can be registered on the RRL. This is the general method used to register devices. However, there are circumstances when a spectrum licensees can register a device that does not meet the requirements of the s.145(4) Determination. For example, area-adjacent spectrum licensees can reach an agreement with each other to allow the registration of a device that exceed the DBC. Such agreements are typically done on a case-by-case basis.

A summary of the proposed changes to the s.145(4) Determination is provided in Table 2. The draft variation instrument for the s.145(4) Determination is provided at Appendix B, which is attached separately in the key documents section of this consultation.

### General changes

Most of the proposed changes are aligned with those identified and implemented in the review of the [2.3 GHz technical framework](https://www.acma.gov.au/consultations/2020-12/review-23-ghz-spectrum-licencing-technical-framework-consultation-372020) (referred to as general changes). The ACMA is progressively considering implementing these general changes to s.145(4) determinations in all spectrum licence bands as they come up for review. The only difference in the case of the 3.4 GHz band were the actual values used for the level of protection (LOP). In this case the current LOP of -98 dBm/MHz is proposed to be maintained for devices using non-AAS. While an 8 dB factor (to account for the dynamic interference environment associated with AAS) is applied to this LOP for devices using AAS.

The general changes will enable spectrum licensees to deploy services closer to the geographical boundaries of their licence, subsequently increasing utility of the spectrum. While notionally increasing the interference environment to licensees, the impact is considered to be acceptably low for the following reasons:

* The general changes were supported by all 3.4 GHz spectrum licensees in   
  the TLG.
* The geographical boundaries of the 3.4 GHz spectrum licence space are generally located in regional and remote areas. Demand for access to spectrum in these areas is typically lower, consequently the effect of a higher level of emissions leaving the spectrum licence space is also expected to be low. In addition, transmitters associated with apparatus licences issued outside the 3.4 GHz spectrum licence space are subject to a DBC that assumes unsynchronised use. This naturally increases their separation from spectrum licence area boundaries, resulting in greater protection for any associated apparatus licence receivers.

One aspect of the general changes is to include a grandfathering clause for existing device registrations. This makes it clear that a device is only required to adhere to the s.145(4) Determination that is in force at the time a device is registered. This avoids any uncertainty over the impact the proposed changes may have on existing device registrations. However, the grandfathering clause, as currently proposed, does not cover minor modifications to an existing registration. For example, changes that results in the same or lower horizontal radiated power for the purposes of device boundary calculations. Alternatively, changes that result in the same or smaller device boundary as originally calculated when registering a device. A summary of the changes proposed is outlined in Table 2.

The ACMA is interested in feedback as to whether such minor changes should be included in the grandfathering clause, and if so, what minor changes should be permitted?

Proposed amendments to the s.145(4) Determination

|  |  |
| --- | --- |
| Item | Detail of amendment |
| 3.4 GHz definition | Change to 3400–3700 MHz |
| Level of protection (LOP) | Non-AAS: -98 dBm/MHz (this is the current LOP)  AAS: -90 dBm/MHz |
| Digital elevation model (DEM) | Adopt 3-sec DEM |
| Size of the increment along each radial that the DBC is calculated | Change to 100 m (currently 250 m) |
| Maximum number of increments along each radial (denoted by ‘m’ in the s.145(4) Determination) that the DBC is calculated | Change to 1080. For an increment of 100 m this equates to a maximum DBC radial length of 108 km (currently ‘m’ is 432 for 250 m increment which also equates to 108 km). |
| Propagation modelling | Specify that ITU-R P.525 (free-space path loss) is to be used in calculations along with ITU-R P.526 (diffraction).  Inclusion of clutter loss for stations that are at height 6 m or lower based on Recommendation ITU-R P.2108-0. If the loss calculated is less than 0 dB, the calculated loss value is replaced with 0 dB. If the loss calculated is greater than 8 dB, the calculated loss value is replaced with 8 dB. |
| Grandfathering clause for existing device registrations | While changes identified are unlikely to affect existing registrations, to ensure this an additional clause will be added. This will state that devices are required to meet the requirements of the  s.145(4) Determination in force at the time of registration. |
| Exemption for NBN Co devices from meeting the DBC at urban excise boundary | Transmitters operating under an NBN Co 3.4 GHz spectrum licence, with an occupied bandwidth wholly within the 3400–3475 MHz band, will not be required to meet the DBC into urban excise areas. This is intended as a temporary measure before arrangements for use of urban excise areas are finalised and implemented. |

### Additional changes

As part of the process to implement the arrangements detailed in the outcomes paper, NBN Co’s apparatus licences in the 3400–3575 MHz band were converted to spectrum licences. Following this, NBN Co and Optus subsequently agreed to defragment their spectrum holdings. This work was finalised on 13 July 2021. It is expected that NBN Co will seek to surrender their spectrum licence covering urban excise areas later this year.

To facilitate retuning of devices during the defrag process, a condition was attached to NBN Co licences exempting them from registering devices operating under their licences until February 2022. Now that the defrag process is completed, NBN Co are in the process of re-registering their retuned devices. Many of these devices are near urban excise area boundaries. They would not meet the existing DBC requirements once NBN Co surrender their urban excise area spectrum licence.

To ensure NBN Co are not prevented from re-registering existing services, it is proposed to exempt their devices operating in the 3400–3475 MHz band from having to meet the DBC at urban excise area boundaries. In the long term, the intention is that such interference will be managed by the measures developed for use of urban excise areas. The proposed changes to the s.145(4) Determination are intended as a temporary measure before the long-term arrangements are finalised and implemented. It is noted that, during this interim period, the proposed changes will also enable NBN Co to modify their network to react to any changes in demand. This includes increasing sectorisation at an existing site, deploying new sites or migrating from 4G to 5G services.

### Question 1

Comment is sought on the draft amendments to the s.145(4) Determination contained at Appendix B (separate attachment in key documents section of this consultation).

Should additional measures be included to also grandfather device registrations when minor modifications are made? If so, what minor modifications should be permitted? For example, changes that results in the same or lower horizontal radiated power for the purposes of device boundary calculations? Alternatively, changes that result in the same or smaller device boundary as originally calculated when registering a device?

## Receiver spurious emission limits

The current receiver spurious emission limits for registered receivers (i.e., base stations) operating under 3.4 GHz spectrum licences are reproduced in Table 3. The TLG identified that these emission limits are equivalent to the limits defined in 3GPP technical specification 38.104 ([3GPP TS 38.104](https://www.3gpp.org/DynaReport/38104.htm)) for non-AAS devices with a single receiver. Different limits under the technical specification apply for non-AAS with multiple receivers. Different limits also apply for AAS receivers.

There is interest from equipment manufacturers and 3.4 GHz spectrum licensees to modify the limits to align with 3GPP technical specifications. Aligning technical criteria with 3GPP technical specifications allows licensees to tap into global economies of scale for equipment. This needs to be balanced though with considerations given to managing interference with services operating outside of the 3.4 GHz spectrum licence band.

Current limits for Registered devices – non-AAS and AAS receiver unwanted emission limits outside the 3360–3840 MHz frequency band

|  |  |  |
| --- | --- | --- |
| **Frequency  range (f)** | **Total radiated power**  **(dBm)** | **Measurement bandwidth** |
| 30 MHz ≤ f ≤ 1 GHz | -57 | 100 kHz |
| 1 GHz ≤ f ≤ 19 GHz | -47 | 1 MHz |

3GPP TS 38.104 defines non-AAS receiver spurious emission limits in terms of conducted power for each individual receiver. Having the limits defined as a total radiated power (TRP) mean they apply to all receivers associated with a device (or equivalently operating within an individual cell/sector) rather than individual receivers.

To align with 3GPP TS 38.104, non-AAS receiver spurious emission limits should be defined in terms of mean power (equivalent to conducted power) per receiver port as shown in Table 4. While these levels are higher than the existing receiver spurious emission limits, they are still lower than those defined for non-AAS transmitters. Consequently, adopting these limits is expected to have a negligible effect on the interference environment for adjacent band services.

3GPP non-AAS receiver unwanted emission limits outside the   
3360–3840 MHz frequency band for base stations

|  |  |  |
| --- | --- | --- |
| **Frequency  range (f)** | **Mean power (dBm)**  **per receiver antenna port** | **Measurement bandwidth** |
| 30 MHz ≤ f ≤ 1 GHz | -57 | 100 kHz |
| 1 GHz ≤ f ≤ 19 GHz | -47 | 1 MHz |

3GPP TS 38.104 V15.1.0, which was released in April 2018, defined the limits in Table 4 plus 9 dB (using TRP instead of mean power per receiver port) for AAS receiver spurious emissions. These were the limits defined by 3GPP during the last major review of the 3.4 GHz spectrum licence technical framework in 2018. Ultimately, the limits in Table 3 were adopted for 3.4 GHz spectrum licences.

Since that time, versions 16 and 17 of 3GPP TS 38.104, released from July 2019, specify the modified AAS receiver spurious emission limits shown in Table 5. As these limits are defined in terms of TRP, they place a cap on emissions from all receivers associated with a device (or equivalently operating within an individual cell/sector). The modified 3GPP TS 38.104 limits are higher than the current limits and mirror the spurious emission limits currently in place for AAS transmitters in the 3.4 GHz band. Consequently, adopting these limits is expected to have a negligible effect on the interference environment for adjacent band services.

3GPP AAS receiver spurious emission limits outside the   
3360–3840 MHz frequency band for base stations

|  |  |  |
| --- | --- | --- |
| **Frequency  range (f)** | **Total radiated power (dBm) per cell/sector** | **Measurement bandwidth** |
| 30 MHz ≤ f ≤ 1 GHz | -27 | 100 kHz |
| 1 GHz ≤ f ≤ 19 GHz | -21 | 1 MHz |

Considering these issues, it is proposed to make the following changes to align with the latest versions of 3GPP 38.104:

* Redefine the receiver spurious emission limits for non-AAS receiver in Table 4 in terms of mean power (rather than total radiated power) and clarify that the limits apply to individual receivers.

Adopt the receiver spurious emission limits for AAS set out in Table 5.

Include a note to clarify that, for time division duplex (TDD) devices, the receiver spurious emission limits only apply during periods the associated transmitter is not operating. This is not clear on existing 3.4 GHz spectrum licences.

### Question 2

Comment is sought on the proposed changes to receiver spurious emission limits on 3.4 GHz spectrum licences detailed in Tables 4 and 5 for non-AAS and AAS receivers respectively.

## RALI MS44

One of the conclusions from the outcomes paper was that RALI MS44 would be amended to include relevant parts of the 3400–3575 MHz band to the list of frequencies offered protection at existing east Australian ESPZs as well as the Uralla earth station facility. Importantly, those parts of the 3400–3575 MHz band currently subject to spectrum licensing, or proposed for conversion to spectrum licensing, would not be included. It is noted that the entire 3400–4200 MHz band is currently offered protection at the Mingenew ESPZ in Western Australia. Consequently, this ESPZ did not need to be considered in the review of RALI MS44.

The following frequency ranges within the 3400–3575 MHz band cannot be included into RALI MS44 as previous ACMA and Ministerial decisions have made them available for spectrum licensing:

The 3442.5–3475 MHz and 3542.5–3575 MHz frequency ranges. These are currently subject to spectrum licensing in metropolitan and regional areas. They were re-allocated for the issue of spectrum licences in the year 2000. The area covered by existing licences encompasses all east coast ESPZs as well as the Uralla earth station facility.

The 3400–3442.5 MHz and 3510–3542.5 MHz frequency ranges. In December 2020, the Minister for Communications, Urban Infrastructure, Cities and the Arts made the *[Radiocommunications (Spectrum Designation—3.4 GHz Band)   
Notice 2020](https://www.legislation.gov.au/Details/F2020L01661)* (3.4 GHz designation notice). The intention of this designation notice was to enable the conversion of NBN Co’s 3.5 GHz Public Telecommunications Service (PTS) apparatus licences to spectrum licences. The associated conversion process was completed on 7 July 2021. The resulting licences issued to NBN Co encompass significant portions of the Quirindi ESPZ in the 3400–3442.5 MHz and 3510–3542.5 MHz bands. Other ESPZs and the Uralla earth station facility are not contained within spectrum licences issued.

Table 6 summarises the segments of the 3400–3575 MHz frequency range that are proposed for inclusion into RALI MS44 for each ESPZ as well as the Uralla earth station facility. These are included in a draft update to RALI MS44 provided at Appendix C (found separately in key documents section of this consultation).

Frequency ranges proposed for inclusion into RALI MS44 (Note 1)

|  |  |
| --- | --- |
| ESPZ | Frequency ranges |
| Moree | 3400–3442.5 MHz, 3475–3542.5 MHz |
| Roma | 3400–3442.5 MHz, 3475–3542.5 MHz |
| Quirindi | N/A |
| Uralla | 3400–3442.5 MHz, 3475–3542.5 MHz |

Note 1: The entire 3400–4200 MHz band is currently offered protection at the Mingenew ESPZ in Western Australia.

### Question 3

Comment is sought on the draft amendments to RALI MS44 contained in Appendix C (found separately in key documents section of this consultation).

# Options for use of spectrum in urban excise areas

This section identifies and assesses planning and licensing options for making spectrum in urban excise areas available for wireless broadband use. Two technical deployment scenarios inside urban excise areas were considered when developing these options:

a macro-cell[[11]](#footnote-12) scenario

a restricted cell[[12]](#footnote-13) scenario.

Furthermore, multiple licensing access approaches were also identified, each of which could be compatible with the technical deployment scenarios outlined above:

single user (operator) in each frequency segment licensed over the entirety of each urban exercise area

multiple user (operator) in each frequency segment licensed over parts of each urban exercise area.

The ACMA performed studies to assess the viability of the 2 technical deployment scenarios using an aggregate C/(N+I) criteria for the protection of NBN Co services. These studies are provided at Appendix D*Assessment of utility of 3.4 GHz urban excise areas* in the key documents section of this consultation (they also form part of the [3.4 GHz TLG paper](https://www.acma.gov.au/spectrum-licence-technical-liaison-groups)).

After reviewing the studies, the ACMA has concluded that a restricted cell scenario is feasible while providing sufficient protection to NBN Co services. However, a macro-cell scenario, with a reasonable sized network deployed, was not feasible in most areas with current equipment capabilities.[[13]](#footnote-14) Some TLG members believed this may change in the next few years (for example, if/when greater control in the elevation plane for AAS beam steering becomes available).

In identifying options, the ACMA has also considered the different wireless broadband use cases that may be supported in urban excise areas. Specifically use cases that are focussed on wide area public networks over large portions of the urban exercise areas (for example, characterised by the mobile network operator model) and either enterprise or private network uses cases covering local areas of the urban excise area.

Once a decision has been made on which option to adopt, the ACMA will move to implement that outcome. This includes finalising interference management criteria, developing RALIs and making/updating relevant legislative instruments. Where it makes sense to do so, it is proposed any work will be combined with similar work being conducted to implement the [*Replanning the 3700–4200 MHz band: Outcomes paper*](https://www.acma.gov.au/consultations/2020-07/planning-options-3700-4200-mhz-band-consultation-222020). For example, this would include combining public consultation on changes to legislative instruments, consultation on RALIs and/or combining processes to allocate AWL or spectrum licences.

When reading this section, please note that:

* Urban excise areas are defined at [Appendix A](#_Appendix_A:_Urban) and occupy the 3400–3475 MHz frequency range.
* No changes are proposed to existing arrangements for ultra-wide band services detailed in the [*Radiocommunications (Low Interference Potential Devices) Class Licence 2015*](https://www.legislation.gov.au/Series/F2015L01438).

## Identification of options

The ACMA has identified 4 options for making urban excise areas available for wireless broadband uses. These are detailed in Table 7. A pictorial description of each option is provided in Figure 3.

We also acknowledge that there is an option for ‘no change’. Under this option, use of spectrum in urban excise areas could be re-assessed as equipment capabilities evolve, which may change the technical coexistence considerations. While this could enable macro cell deployments, we consider this outcome is adequately covered by Options 1 and 4.

### Question 4

Comment is sought on the options developed for use of spectrum in urban   
excise areas.

Figure 3: Pictorial description of options for urban excise use.[[14]](#footnote-15)Graphical user interface, text, application, email

Description automatically generated

Note: This is illustrative only; the number of operators and licensed bandwidths for each will ultimately be determined as part of any allocation process.

Options for use of spectrum in urban excise areas

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Option | Technical model | Access model | Licence model | Description |
| Option 1 | Macro cell | Single operator per frequency segment across entire urban excise area | Spectrum licence or area wide licence (AWL) | Under this option, a single operator would take out a licence in each urban excise area for a given frequency range. Multiple operators could be supported in different segments of the  3400–3475 MHz frequency range. To manage interference between different licensees, relevant co-channel and adjacent channel boundary conditions would be implemented. This may limit service deployments to small cells initially. Macro-cell deployments may be possible in the future as equipment capabilities evolve. |
| Option 2 | Restricted cell | Single operator per frequency segment across entire urban excise area | Spectrum licence or AWL | Under this option, a single operator would take out a licence in each urban excise area for a given frequency range. Multiple operators could be supported in different segments of the  3400–3475 MHz frequency range. To manage interference between different licensees, relevant co-channel and adjacent channel boundary conditions would be implemented. This includes deployment restrictions such as a low EIRP limit and low outdoor antenna heights (i.e. effectively small cell operation) and other possible restrictions. |
| Option 3 | Restricted cell | Multiple operators across entire urban excise area – either within excusive frequency segment or shared | Apparatus licence (possibly AWL) or class licence | Under this option, multiple operators could share access to the same frequency in an urban excise area and/or by operating in different segments of the 3400–3475 MHz frequency range. To manage interference between different licensees, relevant co-channel and adjacent channel boundary conditions would be implemented. This includes deployment restrictions such as a low radiated power limit and low outdoor antenna heights (i.e. effectively small cell operation) and other possible restrictions. |
| Option 4 | 3400–3460 MHz  macro cell  3460–3475 MHz  restricted cell | 3400–3460 MHz: Single operator per frequency segment across entire urban excise area  3460–3475 MHz:  Depends on which of Option 2/3 is adopted | 3400–3460 MHz  spectrum licence or AWL  3460–3475 MHz  spectrum licence, AWL or class licence | Under this option, any combination of the Options 1-3 could be implemented in different segments of the 3400–3475 MHz frequency range. The ACMA propose the best combination would be Option 1 and Option 2 or 3 being implemented in the 3400–3460 MHz and  3460–3475 MHz segments respectively. |

## Possible interference management criteria

When developing options for use of spectrum in urban excise areas, we identified that the current measures used to manage interference in the 3.4 GHz spectrum licence technical framework will not be appropriate in all cases. Consequently, alternate measures have been developed for consideration.

Possible criteria to manage interference to and from services operating in urban excise areas have been identified for each option. These criteria are informed by discussions in the TLG process. Pending a decision on an implementation option, the ACMA will consult further on the interference management criteria before finalising and implementing the option. Criteria are presented in this paper for information as they may assist stakeholders in developing views on a preferred option. Stakeholders are also free to provide their views on the possible criteria as part of a response to this paper.

The criteria aim to manage co-channel and adjacent channel/adjacent band interference between licensees. In some instances, 2 possible approaches have been identified to manage a specific interference scenario. For example, adjacent channel/band interference could be managed via use of a synchronisation requirement or a restricted use band. In the case of co-channel interference, different measures to manage the level of emissions into an adjacent area licence are identified. This includes a possible synchronisation requirement that assists in the management of interference caused by ducting.

A summary of the possible approaches to manage interference for each option provided at [Appendix E](#_Appendix_E:_Possible). Refer to the 3.4 GHz TLG paper for further details on how these were developed.

### Question 5

Views are sought on the possible interference management approaches for both co-channel mechanisms (including ducting) and adjacent channel mechanisms (including adjacent band coexistence) contained at [Appendix E](#_Appendix_E:_Possible).

## Assessment of options

A key decision in the 2019 outcomes paper was to make spectrum in urban excise areas available for wireless broadband uses. The ACMA has identified the following desirable planning outcomes to use when assessing the options identified for use of urban excise areas:

Provide adequate protection to incumbent NBN Co services in adjacent areas.

Ensure NBN Co is not unreasonably constrained in their ability to deploy new and more spectrally efficient technologies in the future (e.g., moving from 4G to 5G technologies).

Minimise the impact any new arrangements may have on existing 3.4 GHz spectrum licences above 3475 MHz.

Maximise the utility of spectrum in urban excise areas for new wireless broadband services.

### Question 6

Comment is sought on the desirable planning outcomes for use of spectrum in urban excise areas.

The following sections contain the ACMA’s preliminary assessment of each of the options against the desirable planning outcomes. The assessment also considers other relevant issues, including the benefits of single versus multi-operator options, macro-cell versus restricted cell models and the timeframes spectrum could be made available under each option.

**Desirable planning outcome 1:** Provide adequate protection to incumbent NBN Co services in adjacent areas.

In 2015, as a result of the [Australian Communications and Media Authority (3.5 GHz frequency band) Direction 2014](https://www.legislation.gov.au/Details/F2014L01399), NBN Co were issued apparatus licences that covered urban excise and surrounding areas. Since that time, they have deployed terrestrial wireless broadband services at about 1000 locations (based on RRL data) under the licences issued. It is understood that the roll out of their terrestrial wireless broadband network is now largely complete.

Importantly the design of this network did not take into account potential use and interference from co-frequency deployments in urban excise areas operated by other users. Such use represents a shift from the existing environment and creates a new coexistence environment to consider.

To maximise their size, urban excise areas were defined to include those areas of capital cities that were not part of NBN Co’s terrestrial fixed wireless service area. This means a large number of NBN Co’s services are located near the urban excise boundary with little or no geographical separation between them. This creates a challenging coexistence environment.

This situation is different to a scenario where an operator is issued a licence where the boundaries are pre-defined, and they are aware of possible future co-frequency use in adjacent areas. In such cases, an operator can design their network and deploy services that take this into account. Often this involves some form of geographical separation between services and shared area boundaries – something that many existing NBN Co services gain limited benefit from with urban excise areas.

To account for this while recognising the benefits of the services provided by NBN Co, measures need to be put in place to achieve coexistence through managing interference between NBN Co services and future uses/users of urban excise areas.

It is important to note that there will naturally be a trade-off between the level of protection provided to NBN Co services and the utility that can be derives from use of spectrum in the urban excise areas by new wireless broadband services. For example, a more conservative protection criteria for NBN Co services corresponds to a reduction in utility of spectrum available in urban excise areas. Consequently, a suitable balance needs to be identified. It is expected that these would be based on the criteria detailed in [Appendix E](#_Appendix_E:_Possible). The final detail of what these measures will look like will be addressed in future consultation processes.

One of the key issues identified in the TLG, was whether to include measures to protect NBN Co services from potential interference caused by ducting. Ducting is a form of anomalous propagation that can occur under certain conditions. When an atmospheric duct forms, radio waves that travel along it experience less attenuation.

A detailed assessment of the interference effects of ducting is difficult to quantify and depends on both the nature of the ducts and of the systems susceptible to interference. In the case of the 3.4 GHz band, the ACMA is aware of the possibility of ducting related interference potentially occurring up to a few hundreds of kilometres away from a transmitter for periods of minutes/hours or even days at a time, with events usually occurring during specific times of the year. Interference due to ducting is generally only seen between devices that are located above the local clutter (i.e., above rooftops and treetops), such as macro cell base stations. Additionally, the impact of the interference is also variable and may at times result in a reduction in throughput as opposed to completed failure of the service.

This issue was identified as a major sensitivity in the TLG. NBN Co supported implementation of additional specific measures to further mitigate the risk of ducting interference while other 3.4 GHz spectrum licensees did not. Further discussion on this issue is provided at [Appendix E](#_Appendix_E:_Possible).

**All Options:** The ACMA considers that suitable interference management criteria can be developed for all options to provide NBN Co services with sufficient protection.

For Options 1 and 4 (the options that support macro cell deployments), the issue of whether to include measures to manage interference caused by ducting will need to be considered. The ACMA considers this would not be needed for Options 2 and 3 (restricted cell options). Such interference should be adequately addressed by restrictions on service deployments such as limits on radiated power and antenna heights.

**Desirable planning outcome 2:** Ensure NBN Co is not unreasonably constrained in their ability to deploy new and more spectrally efficient technologies in the future.

It is understood that NBN Co have largely completed the rollout of their terrestrial fixed wireless network and the areas they are required to provide associated services are well defined. However, the ACMA is aware that NBN Co have plans to migrate their network from 4G to 5G (and likely other next generation technologies) in the future. This includes deploying AAS at existing base station sites which are capable of operating with higher antenna gains utilising steerable beams. NBN Co may also need to address changes in demand by increasing sectorisation at existing base station sites, this also typically involves deploying more directional-higher gain antennas. Implementing these measures has the potential to change the coexistence environment with uses of the urban excise areas through increasing the level of interference into urban excise areas.

The ACMA considers that any option implemented for use of urban excise areas should provide reasonable flexibility to enable NBN Co to implement these measures. It is recognised that there will be a trade-off between the degree of flexibility provided to NBN Co and providing certainty to urban excise licensees on future changes to the interference environment they operate in. For example, a measure that places some constraints on NBN Co’s ability to modify existing base stations, could enable urban excise operators to design and deploy services that take this into account.

**Options 1 and 4:** The ACMA considers that suitable measures can be put in place that provide reasonable flexibility for NBN Co to adopt new and more spectrally efficient technologies at existing base station sites in the future. As Options 1 and 4 support macro cell deployments, which are often located above rooftops and the treetops, services in urban excise areas may be more susceptible to a change in interference environment. For these options is it likely any measures implemented will need to place some reasonable constraints on NBN Co’s ability to adopt new technologies. Possible measures are detailed in Table 10 of [Appendix E](#_Appendix_E:_Possible).

**Options 2 and 3:** The ACMA considers that suitable measures can be put in place that provide reasonable flexibility for NBN Co to adopt new and more spectrally efficient technologies at existing base station sites in the future. Options 2 and 3 support a restricted cell scenario. This means base stations (as with user terminals) will typically be located either indoors or below the clutter (i.e., below building and treetops), which would provide them additional protection from NBN Co service emissions. Consequently, it may be possible to implement measures that place few or no restrictions on NBN Co to adopt new technologies. Possible measures are detailed in Table 10 of [Appendix E](#_Appendix_E:_Possible).

**Desirable planning outcome 3:** Minimise the impact any new arrangements may have on existing 3.4 GHz spectrum licences above 3475 MHz.

To minimise the impact on adjacent band 3.4 GHz spectrum licences, it is proposed that any arrangements developed will be limited to 3400–3475 MHz range and will only apply in the management of interference to and from an urban excise area. In all other cases, the existing arrangements in the 3.4 GHz technical framework will apply.

The 3.4 GHz technical framework manages adjacent channel interference via a combination of the following mechanisms:

Unwanted emission limits defined in [licence schedule 2 of all 3.4 GHz spectrum licences](https://web.acma.gov.au/rrl/licence_image.extract_pdf?pLICENCE_NO=10917464).

The co-sited devices requirement detailed in [clause 3 of Licence Schedule 4 on all 3.4 GHz spectrum licences](https://web.acma.gov.au/rrl/licence_image.extract_pdf?pLICENCE_NO=10917464).

The synchronisation requirement as detailed in [clause 11 of Licence Schedule 4 on all 3.4 GHz spectrum licences](https://web.acma.gov.au/rrl/licence_image.extract_pdf?pLICENCE_NO=10917464) (this requirement also assists in managing co-channel interference).

As indicated in [Appendix E](#_Appendix_E:_Possible), it is proposed that similar mechanisms be adopted to manage interference to and from urban excise areas. However, while the adoption of the synchronisation requirement is proposed, this is primarily being used to manage co‑channel interference with NBN Co services. As NBN Co currently employs 4G technology, the synchronisation requirement condition mandates use of a 4G frame structure.

It is noted that the synchronisation requirement only applies if there is interference and there is no agreement on how to manage it. This allows mobile network operators (MNOs) to adopt a 5G optimised frame structure in metropolitan areas as NBN Co has no services deployed there. If new services are deployed within urban excise areas, they would likely need to synchronise with NBN Co services to manage co-channel interference. Unless a suitable restricted use band is implemented, this would have a flow on effect of requiring all adjacent band 3.4 GHz spectrum licensees to fallback to a less efficient 4G frame structure.

To minimise the potential impact on adjacent band 3.4 GHz spectrum licences, a restricted use band is required. In this context, a restricted use band refers to a defined frequency range were either no operation is permitted or where operation is only permitted under certain conditions (e.g., agreement between operators). The size of such a band depends on whether a macro cell or restricted cell model is adopted. 3.4 GHz spectrum licensees identified that a minimum 15 MHz restricted use band would be required between unsynchronised macro cell deployments. The ACMA considers that a smaller 5 MHz restricted use band could apply for the restricted cell model. If suitable restricted use bands are not put in place, then adjacent band 3.4 GHz spectrum licensees may be required to modify the operation of their services to manage interference.

In this case, the ACMA considers the use of restricted use bands are appropriate. Operation within these restricted use bands could be permitted via negotiation with the adjacent band spectrum licensee or if operation can be synchronised with the adjacent band licensee.

**Option 1:** The ACMA considers that suitable measures can be put in place to minimise the impact on adjacent band 3.4 GHz spectrum licences. Based on advice from 3.4 GHz spectrum licensees a 15 MHz restricted use band would be sufficient to manage interference between unsynchronised macro-cell deployments.

**Option 2 and 3:** The ACMA considers that suitable measures can be put in place to minimise the impact on adjacent band 3.4 GHz spectrum licences. If services in urban excise areas are limited to a low enough radiated power limit (e.g., 30 dBm), the ACMA considers that a 5 MHz restricted use band could be sufficient to manage interference. Any additional constraints, such as limits on antenna heights and power spectral density limits etc, may also help to improve coexistence.

**Option 4:** The ACMA considers that suitable measures can be put in place to minimise the impact on adjacent band 3.4 GHz spectrum licences. In this case the size of the restricted use band can be minimised while maximising deployment flexibility. Specifically, implementing Option 1 in the 3400–3460 MHz frequency range would require a 15 MHz restricted use band. However, if a restricted cell approach, similar to either Option 2 or 3, was then implemented in the   
3460–3475 MHz frequency range, the size of the restricted use band required would only be 5 MHz.

**Desirable planning outcome 4:** Maximise the utility of spectrum in urban excise areas for new wireless broadband services.

There is a tension between achieving this desirable planning outcome and other desirable planning outcomes. Increasing the utility of spectrum available in urban excise areas increases the risk of interference to NBN Co services and adjacent band 3.4 GHz spectrum licences. Conversely, the more conservative the protection criteria for NBN Co and adjacent band services, the lower the utility of urban excise areas. An appropriate balance needs to be found between these competing objectives.

There are various measures that could be implemented to manage co-channel interference to and from urban excise areas. Possible measures for each option are detailed in [Appendix E](#_Appendix_E:_Possible). The final detail of what these measures will look like will be addressed in future consultation processes once a decision has been made on which option to adopt.

#### Managing adjacent channel interference

There are 2 options to manage interference with adjacent band 3.4 GHz spectrum licences, these are to implement a restricted use band or adopt the synchronisation requirement.

If a restricted use band is implemented, less spectrum in the 3400–3475 MHz frequency range is available for use. If the synchronisation requirement is adopted, the entire 3400–3475 MHz frequency range is available for use. However, as a consequence, adjacent frequency spectrum licensees are likely to require a move from a 5G optimised frame structure to a less efficient 4G frame structure. This would be the case until all affected licensees were ready to move to a 5G optimised frame structure.

In this case, the ACMA considers the best balance between the planning outcomes is to implement a restricted use band. Arrangements put in place would enable deployments in restricted use bands via agreement with the adjacent band spectrum licensee or if operation can be synchronised with the adjacent band licensee. However, the size of the restricted use band should be made as small as possible.

In addition to managing interference between NBN Co services and adjacent band 3.4 GHz spectrum licences, measures to manage interference between different operators inside urban excise need consideration. Only adjacent channel interference needs to be considered for Options 1 and 2. However, co-channel interference needs to be considered for Option 3 and Option 4 (if Option 3 is implemented in the   
3460–3475 MHz frequency range).

It is not proposed to implement a restricted use band between urban excise operators to manage interference. A 5 or 15 MHz restricted use band greatly reduces the amount of usable spectrum in the 3400–3475 MHz band (especially if there is already a restricted use band at the top of the band). It could also be difficult to manage in the multi-operator environment proposed under Option 3.

#### Managing co-channel interference

There are 2 mechanisms identified to manage co-channel interference. These are defining limits on emissions that leave an area and adopting the synchronisation requirement. These can be implemented independently or in combination.

In order to manage interference into NBN Co services, it is considered necessary to have an out of area emission limit. Possible approaches to this are defined in Table 10 in [Appendix E](#_Appendix_E:_Possible). Less conservative criteria can be applied if out of area limits are combined with the synchronisation requirement. Such an approach is used in the 3.4 GHz spectrum license technical framework. This not only reduces the risk of base station to base station interference but allows operators more flexibility to deploy services, resulting in greater spectrum utility.

Adopting the synchronisation requirement means operators in urban excise areas may be required to implement a 4G optimised frame structure to manage co-channel interference with NBN Co services. This is also expected to allow operators to deploy services closer to urban excise area boundaries. While use of a 5G optimised frame structure may be preferred by some operators, the increased spectrum utility associated with adopting the current (4G) synchronisation requirement is considered to outweigh this.

The final detail of what these measures will look like will be addressed in future consultation processes once a decision has been made on which option to adopt.

#### Wide area versus local area wireless broadband (WBB) use cases

A wide area WBB (WA WBB) use case would provide exclusive access to a single operator in a defined frequency in each urban excise area, as proposed under Options 1 and 2. A local area WBB (LA WBB) use case would enable multiple operators to access the same frequency range at different locations within an urban excise area, as proposed under Option 3. Option 4 can be optimised for either WA WBB or a combination of WA WBB and LA WBB depending on how the   
3460–3475 MHz segment is made available for use.

There are numerous bands available and optimised for WA WBB use that encompass urban excise areas. Currently the only apparatus licensed LA WBB spectrum available in urban excise areas is in the 24.7–25.1 GHz and 27.5–29.5 GHz bands. As part of the implementation of the [*Replanning the 3700–4200 MHz band: Outcomes paper*](https://www.acma.gov.au/consultations/2020-07/planning-options-3700-4200-mhz-band-consultation-222020) the ACMA is intending to make mid-band spectrum available for such use in the   
3800–4000 MHz band. Due to incumbent satellite earth station receivers, there may be limited utility of the 3800–4000 MHz band for LA WBB use in Adelaide, Perth and Sydney. In this case the 3400–3475 MHz band presents another opportunity to make more mid-band spectrum available for LA WBB use.

The benefits of an LA WBB use case is that it provides support for multiple operators and allows them to design and operate their own infrastructure. However, there is also an increased risk of interference between different operators. This could limit how close services can be deployed and result in areas between different operators that are of limited utility. The limited spectrum and small size of urban excise areas compounds this further. To reduce the risk of interference and improve spectrum utility, additional deployment restrictions would need to be imposed. This could involve defining emission limits outside of a controlled premise coupled with a need to adhere to a synchronisation requirement.

The benefits of a WA WBB use case are it would likely enable a higher density of deployments and greater spectrum utility. This is because within the small urban excise areas, interference on a specific frequency can be self-managed. Consequently, individual deployments can be modified/optimised accordingly. A WA WBB use case will limit the number of licensees in a band. However, multiple operators could be supported by issuing them licences in different segments of the 3400–3475 MHz band.

**Option 1:** This option provides the greatest flexibility for how operators can use spectrum in urban excise areas – it allows for the deployment of both macro and restricted cells. It is expected that initially, most deployments would follow a restricted cell model. However, discrete macro cell deployments could be considered on a case-by-case basis, either immediately or in the future as equipment capabilities evolve. Under this model, additional arrangements to manage interference due to ducting may need to be considered. If a restricted use band is implemented, only 60 MHz of the 3400–3475 MHz frequency range would become available for use. This results in less of the band being utilised than under Options 2 to 4.

Under Option 1, it is desirable to combine the release of urban excise spectrum with allocation processes for spectrum in the 3700–4200 MHz band. Currently, the ACMA anticipates this could occur between the second quarter of 2022 and fourth quarter of 2023.

**Option 2:** Under this option, similar to Option 3, deployments in urban excise areas are limited to a restricted cell model. This option could result in a higher density of deployments than Option 3. Multiple operators could be supported by issuing them licences in different segments of the 3400–3475 MHz band. The ACMA considers interference due to ducting should be adequately addressed by restrictions on service deployments such as limits on radiated power and antenna heights. If a restricted use band is implemented, up to 70 MHz of the 3400–3475 MHz frequency range could become available for use. This results in more of the band being utilised than under Option 1.

Under Option 2 it is desirable, to combine the release of spectrum with allocation processes for spectrum in the 3700–4200 MHz band. Currently, the ACMA anticipates this could occur between the second quarter of 2022 and fourth quarter of 2023.

* **Option 3:** Under this option, similar to Option 2, deployments in urban excise areas are limited to a restricted cell model. This option provides support for multiple different operators to access spectrum on the same frequency in the same urban excise area.

Under this approach, there is a greater risk of interference of interference between different urban excise operators. To reduce this risk and improve spectrum utility, there may be a need for additional measures compared to Option 3. The ACMA considers that interference due to ducting should be adequately addressed by restrictions on service deployments such as limits on radiated power and antenna heights. If a restricted use band is implemented, up to 70 MHz of the   
3400–3475 MHz frequency range could become available for use. This results in more of the band being utilised than under Option 1.

Spectrum could be made available under this option as early as the first or second quarter of 2022. This could be done independently of allocation processes for spectrum in the 3700–4200 MHz band.

* **Option 4:** The proposed implementation of this option detailed in Table 7 combines parts of Options 1 to 3 to maximise utility of urban excise areas. This results in a solution that provides the greatest flexibility for service deployments in the   
  3400–3460 MHz frequency segment, while also minimising the amount of spectrum used for restricted use bands.
* Under this option, additional arrangements to manage interference due to ducting may need to be considered. Spectrum could be made available under this option in the same time as Option 1 (between the second quarter of 2022 and fourth quarter of 2023).

## Summary of assessment

Table 8 provides a summary of the ACMA’s assessment of each option against the desirable planning outcomes.

Summary of assessment of options against the desirable planning outcomes

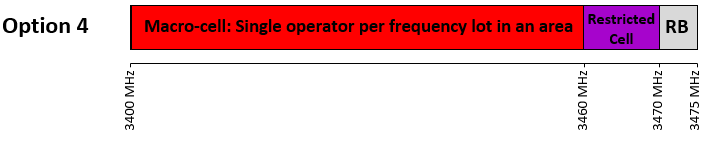
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Option | Desirable planning Outcome 1  *Provide adequate protection to incumbent NBN Co services in adjacent areas* | Desirable planning Outcome 2  *Ensure NBN Co is not unreasonably constrained in their ability to deploy new and more spectrally efficient technologies in the future* | Desirable planning Outcome 3 *Minimise the impact any new arrangements may have on existing 3.4 GHz spectrum licences above 3475 MHz* | Desirable planning Outcome 4  *Maximise the utility of urban excise areas for new wireless broadband services* |
| 1 | Suitable criteria can be implemented. Additional measure to manage interference caused by ducting may need to be considered further. | Suitable measures can be implemented. To manage co-channel interference into urban excise areas, reasonable constraints would likely need to be applied on NBN Co’s ability deploy new technologies. | Adopting a 15 MHz restricted use band would minimise impact to adjacent band 3.4 GHz spectrum licences. This option has the largest restricted use band. | This option supports flexible use for 60 MHz of the band in urban excise areas. This could enable the deployment of macro cells on a case-by-case basis. Allocation of licences could be combined with the release of spectrum in the 3700–4200 MHz band. |
| 2 | Suitable criteria can be implemented. Additional measures to manage interference caused by ducting do not need to be considered. | Suitable measures can be implemented. The most flexible measures to enable NBN Co to do this can be adopted under Options 2 and 3. | Adopting a 5 MHz restricted use band would minimise impact to adjacent band 3.4 GHz spectrum licences. Options 2, 3 and 4 have the smallest restricted use band. | Macro-cell deployments would not be possible under this option. This option would likely support a greater density of deployments than Option 3. This is because a single operator model enables co-channel interference within each urban excise area to be self-managed, which makes it easier for individual deployments to be modified/optimised accordingly. Allocation of licences could be combined with the release of spectrum in the 3700–4200 MHz band. |
| 3 | Suitable criteria can be implemented. Additional measure to manage interference caused by ducting do not need to be considered. | Suitable measures can be implemented. The most flexible measures to enable NBN Co to do this can be adopted under Options 2 and 3. | Adopting a 5 MHz restricted use band would minimise impact to adjacent band 3.4 GHz spectrum licences. Options 2, 3 and 4 have the smallest restricted use band. | Macro-cell deployments would not be possible under this option. This option would likely have a lower density of deployments than Option 2. However, multiple operators would be able to deploy a service in any defined frequency range in each urban excise area. Allocation of licences could be done independent of the work in the 3700–4200 MHz band. Spectrum could be made available the fastest under this option. |
| 4 | Suitable criteria can be implemented. Additional measures to manage interference caused by ducting may need to be considered further for part of the band. | Suitable measures can be implemented. To manage co-channel interference into urban excise areas, reasonable constraints would likely need to be applied on NBN Co’s ability deploy new technologies in part of the band. | Adopting a 5 MHz restricted use band would minimise impact to adjacent band 3.4 GHz spectrum licences. Options 2, 3 and 4 have the smallest restricted use band | The proposed implementation of this option combines different aspects of Options 1 with either Option 2 or 3. It enables the deployment of macro cells on a case-by-case basis and has the smallest restricted use band (along with Option 2 and 3). Allocation of licences could be combined with the release of spectrum in the 3700–4200 MHz band. |

## ACMA preliminary preferred option

After considering the assessment of each option against its desirable planning outcomes, the ACMA has identified Option 4 as its preliminary preferred option. This involves adopting Option 1 in the 3400–3460 MHz frequency range and a restricted cell model similar to Option 2 in the 3460–3475 MHz frequency range (noting a 5 MHz restricted use band applies in the 3470–3475 MHz frequency range).

Under this implementation of Option 4, a single operator would hold a licence in each urban excise area in a given frequency range. Multiple operators could be supported by licensing them in different segments of the 3400–3475 MHz frequency range. The number of licensees in an area and the quanta of spectrum licenced to each would be determined as part of an allocation process. An example of what this could look like is provided in Figure 4.

Figure 4: Pictorial description of preliminary preferred implementation of Option 4



We consider this implementation of Option 4 best promotes the long‑term public interest derived from use of the 3400–3475 MHz band. Key points that support this conclusion are:

It provides the greatest flexibility for how operators can use urban excise areas – it allows for the deployment of both macro (if/when technology allows it and/or in areas where it is otherwise possible using existing technology) and restricted cells

It minimises spectrum incorporated into restricted use bands.

It supports a greater density of deployments and spectrum utility in the   
3460–3475 MHz frequency range. It would also allow an operator to combine this spectrum with spectrum below 3460 MHz to deploy services with a larger contiguous bandwidth.

In a given urban excise area, multiple operators could be supported by licensing them in different segments of the 3400–3475 MHz frequency range.

It is recognised that adopting Option 4 would result in less spectrum optimised for LA WBB uses/users in mid-band spectrum in urban excise areas. This is especially the case in Adelaide, Perth and Sydney where incumbent satellite earth stations will affect access to the only other mid-band LA WBB spectrum in the 3800–4000 MHz band (the ACMA is in the process of developing arrangements for access to this spectrum).

However, taking a holistic view considering other spectrum available for LA WBB, ACMA is of the view that, on balance, the increase in technical utility provided by Option 4 outweighs the benefits offered to potential LA WBB uses provided by Option 3. It is noted that the reduced mid band LA WBB opportunities in Sydney, Perth and Adelaide would be partly offset by opportunities in the 26/28 GHz band.

Possible interference management criteria that could be implemented under this option is detailed in [Appendix E](#_Appendix_E:_Possible). The final detail of what these measures will look like will be addressed in future consultation processes once a decision has been made on which option to adopt.

### Question 7

Comment is sought on the ACMA’s preliminary preferred option. Are other options preferred, and if so, why?

# Invitation to comment

## Making a submission

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

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

Submissions by post can be sent to:

The Manager

Wireless Broadband Section

Australian Communications and Media Authority

PO Box 78

Belconnen ACT 2616

The closing date for submissions is **COB, Thursday 30 September 2021**.

Consultation enquiries can be emailed to [freqplan@acma.gov.au](mailto:freqplan@acma.gov.au).

#### Publication of submissions

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

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

#### Privacy

View information about our policy on the [publication of submissions](https://www.acma.gov.au/publication-submissions), including collection of personal information during consultation and how we handle that information.

Information on the *Privacy Act 1988,* how to access or correct personal information, how to make a privacy complaint and how we will deal with any complaints, is available in our [privacy policy](https://www.acma.gov.au/privacy-policy).

# Appendix A: Urban excise areas

The geographical areas covered by urban excise areas are:

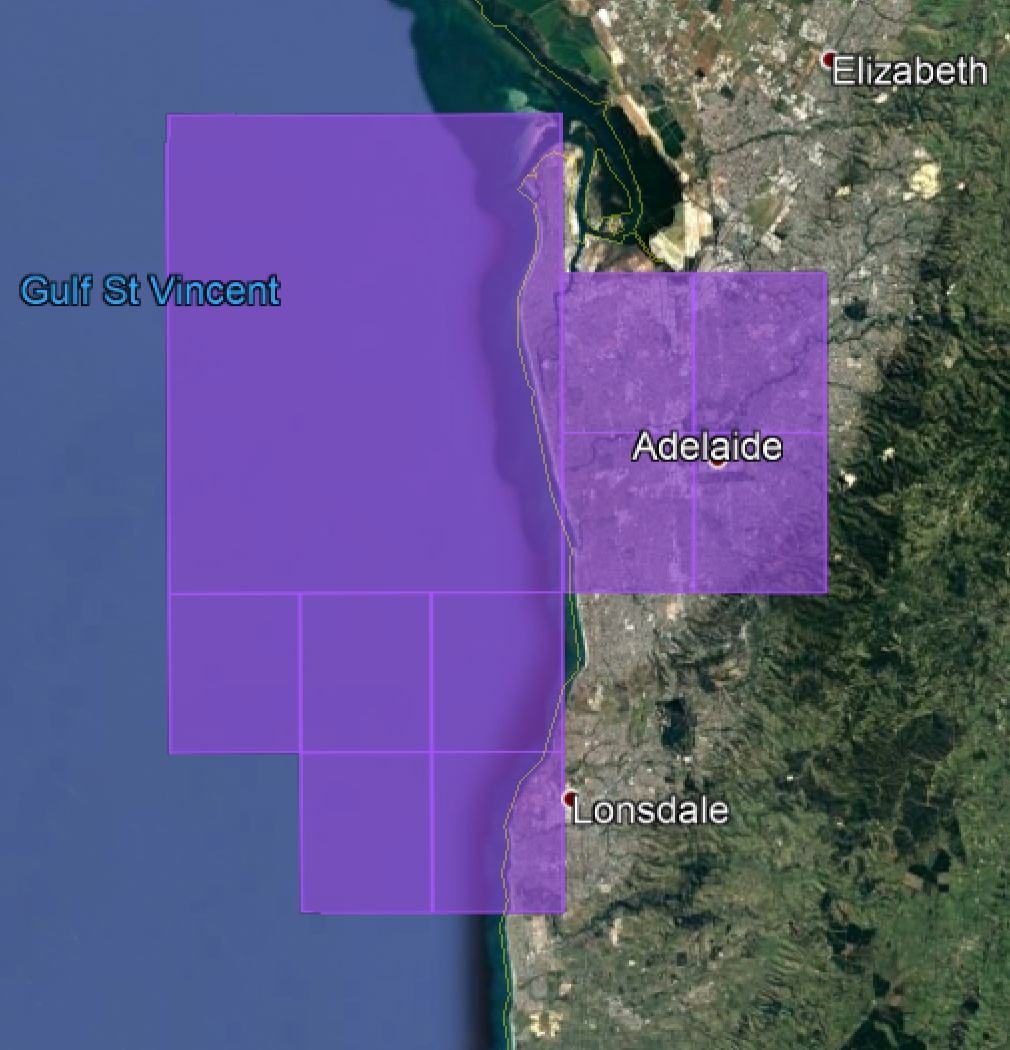
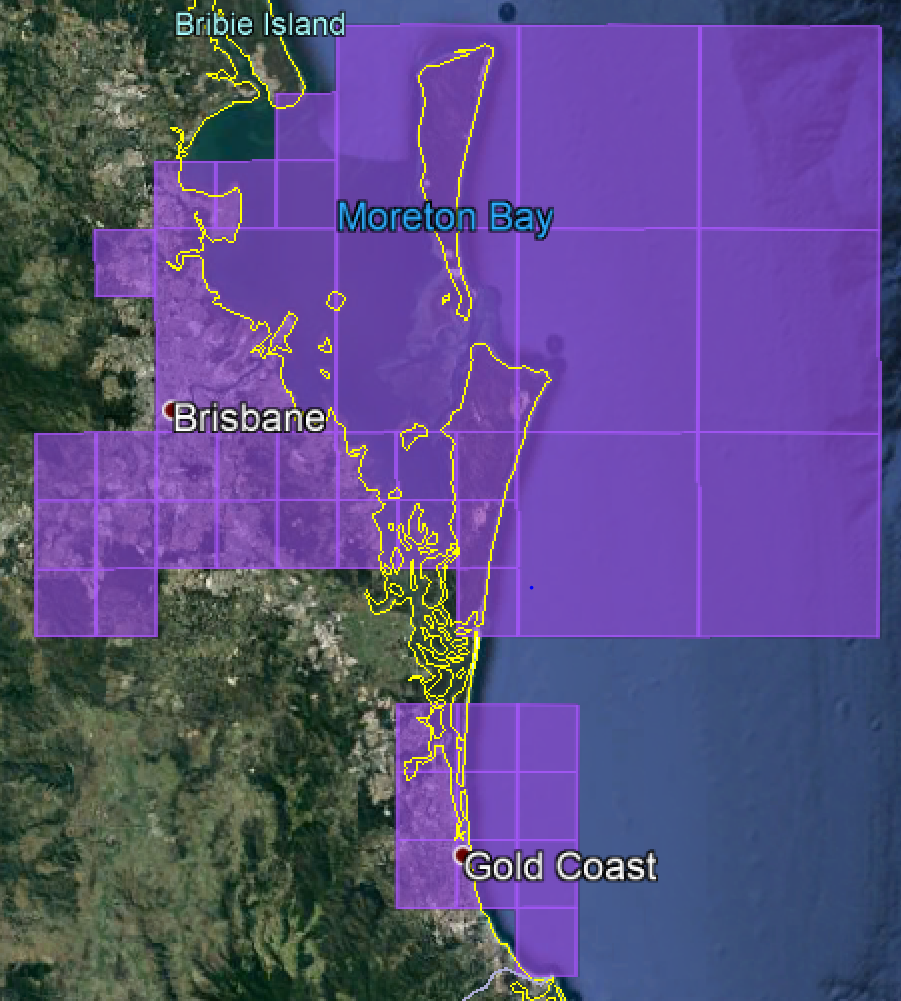
* Described in the Table 9.
* Illustrated in Figure 5.

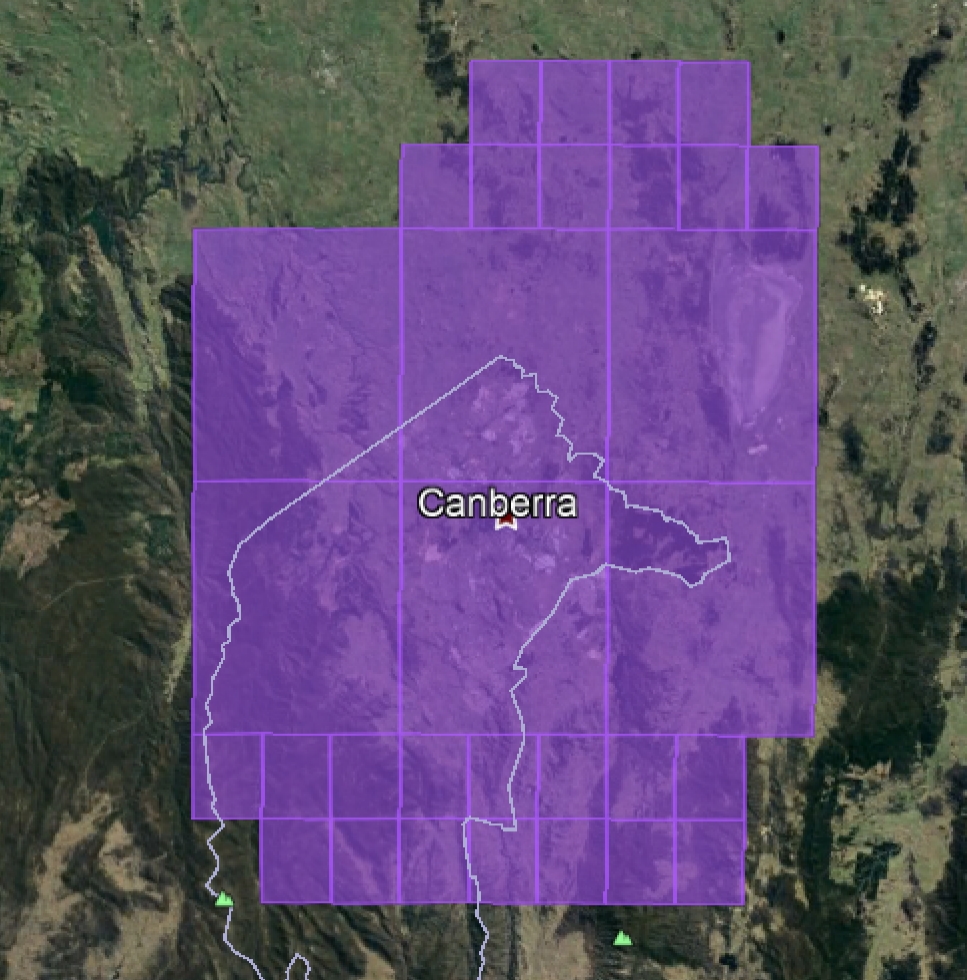
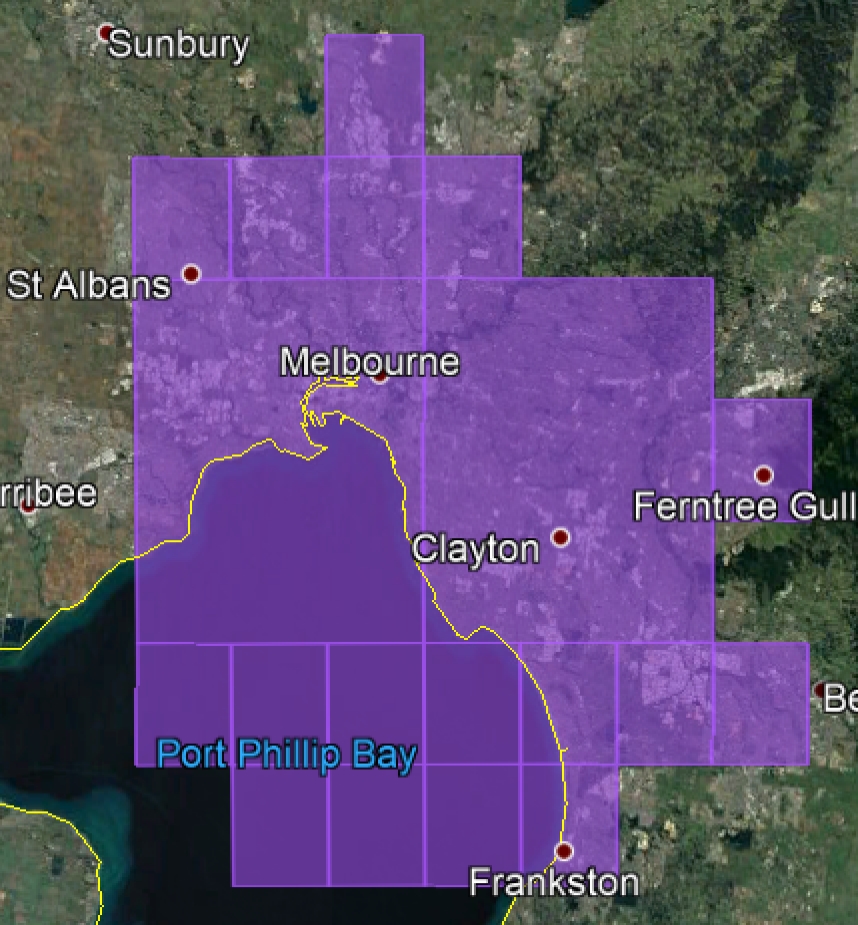
HCIS description of urban excise areas

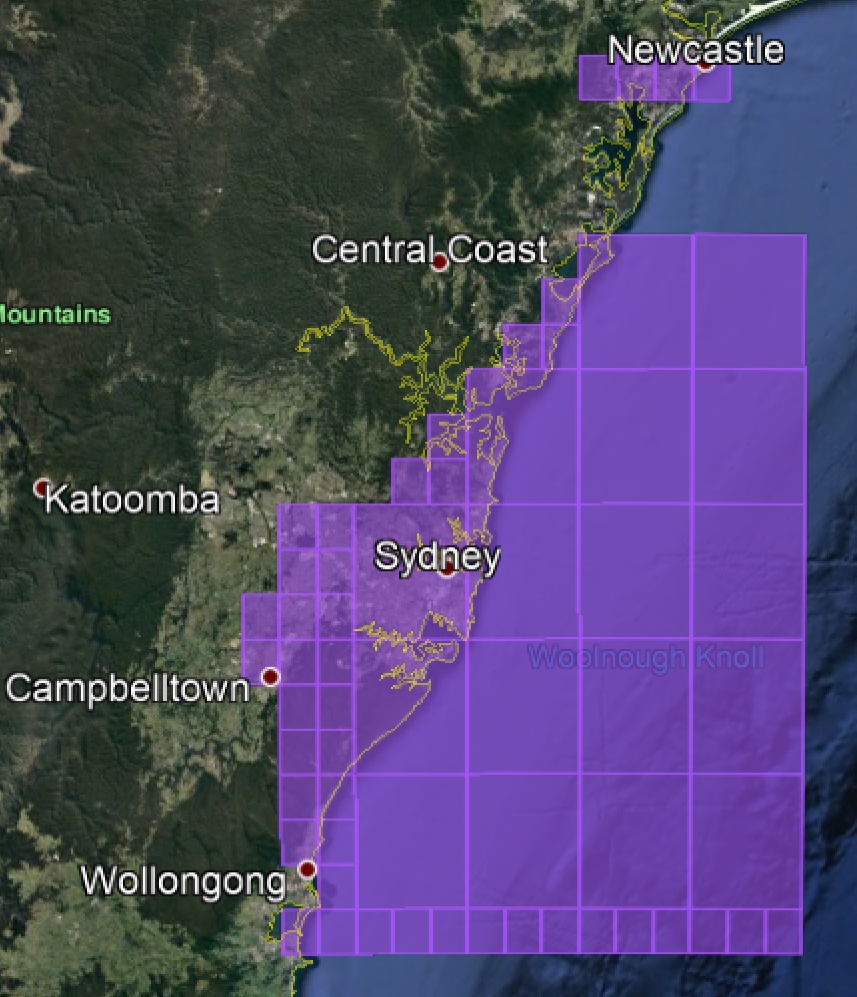
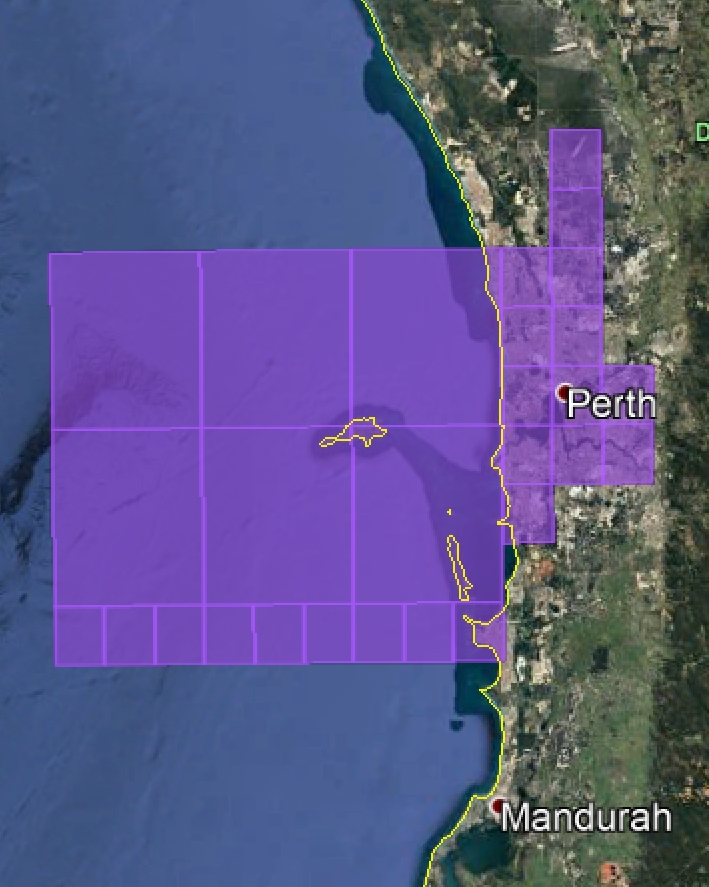
| Sub-area name | HCIS |
| --- | --- |
| Adelaide | IW3N, IW3O4, IW3O5, IW3O7, IW3O8, IW6B1, IW6B2, IW6B3, IW6B5, IW6B6 |
| Brisbane | NT9B, NT9C, NT9D, NT9E, NT9F, NT9G, NT9H, NT9K, NT9L, NT8H3, NT8L2, NT8L3, NT8L5, NT8L6, NT8L8, NT8L9, NT9A6, NT9A7, NT9A8, NT9A9, NT9I1, NT9I2, NT9I3, NT9I4, NT9I5, NT9I6, NT9J1, NT9J2, NT9J3, NT9J4, NT9J5, NT9J6, NT9J9, NT9N5, NT9N6, NT9N8, NT9N9, NT9O4, NT9O7, NU3B2, NU3B3, NU3C1, NU3C4 |
| Canberra | MW4D, MW4H, MW5A, MW5B, MW5E, MW5F, MW2M5, MW2M6, MW2M7, MW2M8, MW2M9, MW2N4, MW2N5, MW2N7, MW2N8, MW2N9, MW4L1, MW4L2, MW4L3, MW4L5, MW4L6, MW5I1, MW5I2, MW5I3, MW5I4, MW5I5, MW5I6, MW5J1, MW5J2, MW5J4, MW5J5 |
| Melbourne | KX3P, KX3L6, KX3L7, KX3L8, KX3L9, KX6D1, KX6D2, KX6D3, KX6D5, KX6D6, LX1M, LX1I7, LX1N4, LX4A1, LX4A2, LX4A3, LX4A4, LX4A5, LX4B1 |
| Perth | BV1M, BV1N, BV1O, BV4A, BV4B, BV4C, BV1L5, BV1L8, BV1P1, BV1P2, BV1P4, BV1P5, BV1P7, BV1P8, BV4D1, BV4D2, BV4E1, BV4E2, BV4E3, BV4F1, BV4F2, BV4F3, BV4G1, BV4G2, BV1P9, BV4D3, BV4D4, BV4G3 |
| Sydney | NV7G, NV7H, NV7J, NV7K, NV7L, NV7M, NV7N, NV7O, NV7P, NW1A, NW1B, NW1C, NW1D, NW1E, NW1F, NW1G, NW1H, MV9P2, MV9P3, MV9P5, MV9P6, MV9P7, MV9P8, MV9P9, MW3D1, MW3D2, MW3D3, MW3D5, MW3D6, MW3D8, MW3D9, MW3H2, MW3H3, MW3H5, MW3H6, MW3H9, MW3L2, MW3L3, NV4O7, NV4O8, NV4O9, NV4P7, NV7F6, NV7F8, NV7F9, NV7I6, NV7I8, NV7I9, NW1I1, NW1I2, NW1I3, NW1J1, NW1J2, NW1J3, NW1K1, NW1K2, NW1K3, NW1L1, NW1L2, NW1L3 |

The HCIS coordinates can be converted into a Placemark file (viewable in Google Earth) through a facility on the [ACMA website](https://acma.gov.au/convert-hcis-area-description-placemark-0).

1. Illustration of urban excise areas (purple areas)

# Appendix E: Possible interference management criteria for urban excise areas

This appendix summarises possible interference management criteria to and from urban excise areas. It is preliminary ACMA commentary on the issues informed by TLG discussions and is intended to assist those commenting on the options identified in this paper. Arrangements would be determined by the ACMA when final regulatory arrangements are developed and would be subject to further consultation.

## Interference mechanisms

To manage interference to/from urban excise areas, the following interference mechanisms were identified for consideration:

**Base station (BS) to base station (BS-BS):** Interference between BS operating in adjacent area and frequency licences.

**BS to user terminals:** Interference from a BS to a user terminal operating in operating in adjacent area or frequency licences. Two cases are defined:

**BS to customer premise equipment (BS-CPE****):[[15]](#footnote-16)** Interference from a BS operating inside an urban excise area to a CPE operating under an NBN Co licence.

**BS to mobile station (BS-MS):** Interference from a BS to an MS operating in an adjacent area or frequency licence.[[16]](#footnote-17)

**User terminals to BS:** Interference from a user terminal to a BS operating in adjacent area and frequency licences. Two cases are defined:

**CPE- BS:3** Interference from a CPE operating under an NBN Co licence to a BS operating in an urban excise area.

**MS-BS:** Interference from an MS to a BS operating in an adjacent area or frequency licence.4

**User terminal to user terminal inference (CPE-MS and MS-MS).**

In addition to the mechanisms above, the TLG identified a preference to manage interference between adjacent channel 4G and 5G systems when they are using different frame structures.

Two possible deployment scenarios were considered for urban excise areas:

A macro-cell scenario

A restricted cell scenario. Under this scenario restrictions would apply such as limits on outdoor antenna heights, radiate power levels, etc.

## Option 1 interference management criteria

Option 1 is intended to support the deployment of macro-cells. A summary of the measures proposed for this scenario is provided in Table 10. Most of these were discussed within the TLG. In addition, as a general rule, licensees would be free to negotiate alternative arrangements with affected parties on a case-by-case basis.

In general, the interference management criteria define geographical and frequency boundary conditions for service deployments under a licence. It is noted that there was no agreement within the TLG on what criteria should be applied for some interference scenarios. Where this was the case 2 possible options were identified. One of the key issues where there was no agreement, was whether to include specific additional measures to protect NBN Co services from interference caused by ducting.

The existing synchronisation requirement for 3.4 GHz spectrum licences, as detailed in [clause 11 of Licence Schedule 4 on all 3.4 GHz spectrum licences](https://web.acma.gov.au/rrl/licence_image.extract_pdf?pLICENCE_NO=10917464), provides a degree of protection from cochannel base station to base station (BS-BS) interference. Specifically, the guard period associated with the synchronisation requirement provides adequate co-channel BS-BS protection out to about 64 km. However, there are cases in the 3.4 GHz and other bands, where cochannel interference can occur at separation distances far beyond this due to anomalous propagation conditions, this is referred to as ducting. This tends to occur between devices that are located above the local clutter, such as base stations. It is currently experienced periodically by all licensees in bands TDD technologies are deployed, this includes the 2.3 GHz and 3.4 GHz bands. Interference due to ducting can be caused from a licensees’ own services or from other licensees’ services.

Existing technical frameworks do not define additional specific measures to manage interference caused by ducting between wireless broadband services. Doing so would reduce utility of the spectrum due to the large distances this type of interference can occur over. Consequently, licensees are required to take this into account when planning and deploying services. This can include negotiating solutions with other parties and employing mitigation techniques where possible (e.g., lower antenna heights, increased antenna down tilts, etc).

It is recognised that that use of spectrum in urban excise areas by other operators represents a significant shift form the interference scenario NBN Co currently experiences in the 3.4 GHz band and would introduce a new source of interference. Specifically, NBN Co would be moving from a situation where they have no co-channel neighbours in metro areas to one where they do. While NBN Co has implemented measures to manage this issue between their own services, these measures may not be sufficient to protect against additional ducting interference from urban excise areas.

During the TLG NBN Co indicated that the effects of ducting could be seen as a reduction in uplink performance in a base station sector or, in the worst case, an outage. Such interference can occur for periods of minutes/hours or even days at a time, but events usually occur during specific times of the year. To manage this, NBN Co proposed the inclusion of a secondary fallback scheme to the synchronisation requirement. The use of the synchronisation requirement would only apply during periods when ducting is a problem (for example during certain times of the year and certain areas). Notionally it would also only apply to those transmitters that are causing interference. However, in practice it may be difficult to determine the exact transmitter that is the source of ducting interference so the requirement may end up be applied to some or all transmitters in an area.

The secondary fallback measure would adopt ‘special subframe configuration 5’ which has a larger guard period than ‘special subframe configuration 6’as defined in Table 4.2.2 of [3GPP TS 36.211](https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=2425). This guard period would assist in managing co-channel interference between base stations up to a distance of 193 km and reduce the affects for some distance beyond that. Due to the larger guard period, this fallback scheme results in a reduction in downlink capacity of approximately 11.7% (based on the reduction in downlink symbols in a 10 ms frame).

Due to the reduction in capacity, during the TLG mobile network operators did not support the introduction of a secondary fallback scheme or other regulatory measures to manage interference caused by ducting. They argued this is an issue all operators experience and need to actively manage between their own and other operators’ services.

Summary of possible interference management criteria for Option 1

|  |  |
| --- | --- |
| **Item** | **Interference management criteria** |
| Unwanted emission limits | Adopt the same unwanted emission limits as defined for existing 3.4 GHz spectrum licences. |
| Synchronisation requirement | **Option A**  Apply the same synchronisation requirement as detailed in clause 11 of Licence Schedule 4 on all 3.4 GHz spectrum licences.  In addition to this, where interference is transient or temporary, for devices operating in the 3400–3475 MHz band, if:  interference is experienced between a device operating in an urban excise area and a device operating in an adjacent area  there is no agreement on how to manage the interference  the interference is not adequately resolved by adopting the synchronisation requirement  then a temporary adoption of special subframe configuration 5 must be implemented within (TBD timeframe) of the notification of the interference for the duration of the interference event. Normal operation can be restored as agreed between the licensees. |
| **Option B**  Apply the same synchronisation requirement as detailed in clause 11 of Licence Schedule 4 on all 3.4 GHz spectrum licences.  Beyond this, as is currently the case, licensees can implement technical measures, where possible and as required, to manage interference due to ducting. This could include negotiating with adjacent area licensees. |
| Application of the current 3.4 GHz device boundary criteria (DBC) | For devices deployed within urban excise areas in the  3400–3475 MHz band, the current DBC does not apply. Alternative measures are defined below for new devices  (both registered and unregistered).  For devices deployed in the 3400–3475 MHz band outside urban excise areas, the current DBC does not apply within urban excise areas. Alternative measures are defined below for new devices (both registered and unregistered).  The current DBC continues to apply as usual for all other cases. |
| Registering new devices inside urban excise areas within the 3400–3475 MHz band | **Option A**  For registered devices, the following measures apply:  Ensuring the power flux density (or alternatively field strength or received power level into a notional receiver) from a proposed BS inside an urban excise area does not exceed  -99.9 dBW/m2/MHz for non-AAS and -91.9 dBW/m2/MHz at a height of 5 metres above ground level within the NBN Co service areas for (TBD)[[17]](#footnote-18) % of locations. This criterion is to be met in NBN Co service areas that are within a 64 km radius of a proposed BS. |
| **Option B**  For registered devices, the following measures apply:  ensuring a proposed BS inside an urban excise area satisfies a minimum aggregate C/(N+I) of 13 dB into a notional CPE within NBN Co service areas for (TBD)1 % of locations. This criterion is to be met in NBN Co service areas that within a 64 km radius of a proposed BS. |
| Registering new devices outside urban excise areas within the 3400­–3475 MHz band | **Option A**  For registered devices, the following measures apply:  Ensuring a proposed BS outside an urban excise area does not exceed -73.9 dBW/m2/MHz for non-AAS and -65.9 dBW/m2/MHz at a height of 1.5 metres above ground level within urban excise service areas for (TBD)1 % of locations. This criterion is to be met inside urban excise areas that are within a 64 km radius of a proposed BS.  Existing measures in the 3.4 GHz spectrum licence technical framework apply in all other cases. |
| **Option B**  For registered devices, the following measures apply:   * Applying similar rules as within urban excise areas. But for C/(N+I) criteria of (TBD)1 dBm into a notional MS.   Existing measures in the 3.4 GHz spectrum licence technical framework apply in all other cases. |
| Unregistered devices inside urban excise areas within the 3400–3475 MHz band | **Option A**  No change to existing requirements. These are:  Operation is only authorised within a licensee’s spectrum space when 3rd party authorised to do so by that licensee.  Devices exempt from registration operate on a ‘no interference and no protection’ basis. |
| **Option B**  Existing requirements on spectrum licences apply to mobile devices. For fixed UEs (or a subset of defined fixed UEs) existing requirements on spectrum licences apply with the exception that:  Fixed UEs in the 3400–3475 MHz band and inside urban excise areas, are deemed not to cause interference to adjacent area licences. |
| Unregistered devices outsideurban excise areas within the 3400–3475 MHz band | **Option A**  No change to existing requirements. These are:  Operation is only authorised within a licensee’s spectrum space when third party authorised to do so by that licensee.  Devices exempt from registration operate on a ‘no interference and no protection’ basis. |
| **Option B**  Existing requirements apply with the exception that:  Fixed UEs associated with the provision of the NBN in the  3400–3475 MHz band, are deemed not to cause interference into urban excise areas. |
| Devices (both registered and unregistered) in the  3475–3700 MHz band | No change to existing requirements. |
| Measures to enable NBN Co to deploy new more spectrally efficient technologies in the future (e.g., 5G, AAS) | **Option A**  Put a condition on all urban excise area licences in the  3400–3475 MHz band which states that licensees cannot claim protection from interference caused by base stations associated with the delivery of the NBN. |
| **Option B**  Before urban excise areas are made available, NBN Co would coordinate and register devices at all new planned or likely new base station sites.  In addition, a condition would be added to the relevant licences or the s.145(4) Determination, that allows NBN Co to deploy higher gain antennas (to a defined point) and larger bandwidths at existing NBN Co BS sites without needing to re-coordinate with services inside urban excise areas. This condition would only apply to NBN Co BS in the 3400–3475 MHz band and only when managing interference into urban excise areas. Prospective urban excise licensees would need to be made aware of this before any licences are issued. This will ensure they can consider it when planning service deployments.  Any new base stations deployed after this condition is put in place would be subject to general coordination rules (e.g., the PFD or C(I+N) coordination described above). |
| Managing interference between 4G and 5G systems | **Option A**  No change to existing requirements |
| **Option B**  For devices operating in the 3400–3475 MHz band inside urban excise areas, a 15 MHz restricted use band will apply when a 4G optimised frame structure is used. No restricted use band is required if the licensee can adopt the same frame structure as the spectrum licensees directly above 3475 MHz. Alternatively, the restricted use band can be relaxed if there is agreement with frequency adjacent spectrum licensees to do so. |

## Option 2 interference management criteria

Option 2 is intended to support a restricted cell scenario. Based on what was considered in the TLG, the ACMA has developed the possible interference management criteria for Option 2 detailed in Table 11. In addition to these, licensees will be free to negotiate alternative arrangements with affected parties on a case-by-case basis.

Summary of possible interference management criteria for Option 2

|  |  |
| --- | --- |
| **Item** | **Interference management criteria** |
| Licence type | Spectrum or apparatus (e.g., AWL) licence |
| General rules for all transmitters | Operation of transmitters is limited to urban excise areas and within the 3400–3470 MHz band (i.e., 5 MHz restricted use band). Operation within the 3470–3475 MHz band is possible via agreement with the adjacent band spectrum licensee.The maximum transmitter effective isotropic radiated power (EIRP) must not exceed 30 dBm.The power spectral density of a transmitter must not exceed 17 dBm EIRP per MHz.Base station transmitters must comply with the unwanted and spurious emission limits described in 3GPP TS 38.104.User equipment transmitters must comply with the unwanted and spurious emission limits described in 3GPP TS 38.101-2.Operation is on a no interference and no protection basis to services operating under other licences.The operation of transmitters must be synchronised with the operation of services operating under adjacent area 3.4 GHz spectrum licences (i.e., NBN Co) that are directly adjacent to urban excise areas. In this case synchronisation means operating in accordance with [clause 11 of Licence Schedule 4 of a 3.4 GHz spectrum licences](https://web.acma.gov.au/rrl/licence_image.extract_pdf?pLICENCE_NO=10917464).The aggregate power flux-density from transmitters operating under an urban excise licence must not exceed -99.9 dBm/MHz/m2 at the boundary of urban excise areas at heights between 5 and 100 metres above ground level. |

## Option 3 interference management criteria

Option 3 is intended to support a restricted cell scenario. Based on TLG discussions, the ACMA has developed possible interference management criteria for Option 3 as detailed in Table 12. The criteria are similar to that developed for Option 2 with extra measures to manage interference between different urban excise licensees. In addition to these, as a general rule, licensees will be free to negotiate alternative arrangements with affected parties on a case-by-case basis.

It is noted that some TLG members queried how practical it would be to synchronise the operation of a large number of small cells, especially if they are operated by multiple different operators.

Summary of possible interference management criteria for Option 3

|  |  |
| --- | --- |
| **Item** | **Interference management criteria** |
| Licence type | Apparatus (e.g., AWL) or class licence |
| Definitions | ‘Controlled premises’means premises that are owned by or under the control of a person who is providing a radiocommunications service under a class licence*.*  Note: If a spectrum licence or AWL approach is adopted, the term ‘controlled premises’ would be defined as the geographical boundary of the licence. |
| General rules for all transmitters | Operation of transmitters is limited to urban excise areas and within the 3400–3470 MHz band (i.e., 5 MHz restricted use band). Operation within the 3470–3475 MHz band is possible via agreement with the adjacent band spectrum licensee.The maximum transmitter EIRP must not exceed 30 dBm.The power spectral density of a transmitter must not exceed 17 dBm EIRP per MHz.Base station transmitters must comply with the unwanted and spurious emission limits described in 3GPP TS 38.104.User equipment transmitters must comply with the unwanted and spurious emission limits described in 3GPP TS 38.101-2.Operation is on a no interference and no protection basis to services operating under other licences.The operation of transmitters must be synchronised with the operation of services operating under adjacent area 3.4 GHz spectrum licences that are directly adjacent to urban excise areas. In this case synchronisation means operating in accordance with [clause 11 of Licence Schedule 4 of a 3.4 GHz spectrum licences](https://web.acma.gov.au/rrl/licence_image.extract_pdf?pLICENCE_NO=10917464).The aggregate power flux-density from transmitters on controlled premises must not exceed –64.9 dBm/MHz/m2 at the external boundary of the controlled premises at a height of 5 metres above ground level.The aggregate power flux-density from transmitters on controlled premises must not exceed –99.9 dBm/MHz/m2 at the boundary of urban excise areas at heights between 5 and 100 metres above ground level. |

## Option 4 interference management criteria

Option 4 is intended to provide support for macro cell deployments in the   
3400–3460 MHz frequency range and a restricted cell scenario in the   
3460–3475 MHz frequency range. In this case, the possible interference management criteria for Option 1 as detailed in Table 10 would be applied across the entire 3400–3475 MHz band with the following additional restrictions:

Operation of transmitters is limited to urban excise areas and within the   
3400–3470 MHz band (i.e., 5 MHz restricted use band). Operation within the   
3470–3475 MHz band is possible via agreement with the adjacent band spectrum licensee or if operation can be synchronised with the adjacent band licensee.

* Within the 3460–3470 MHz frequency range, the power spectral density of a transmitter must not exceed a defined power spectral density limit; for example, 17 dBm EIRP per MHz.

In addition, licensees will be free to negotiate alternative arrangements with affected parties on a case-by-case basis.

1. For the purposes of the options paper, a macro-cell is considered to refer to a base station within a mobile network that provides radio coverage to user terminals over a large area. They are typically characterised by transmitters with high power and high gain antennas with antennas mounted on towers, masts, roof-tops and other existing structures to support wide-area coverage [↑](#footnote-ref-2)
2. For the purposes of the options paper, a restricted cell is considered to be a base station that has some form of restrictions on its operation that limits or reduces the size of the radio coverage to user terminals (e.g., limits on radiated power and antenna heights). It encompasses terms such as micro-cells, small cells, femtocells, etc. [↑](#footnote-ref-3)
3. In context of this paper, a restricted use band refers to a defined frequency range were either no operation is permitted, or operation is only permitted under certain conditions (e.g., agreement between operators). [↑](#footnote-ref-4)
4. A TLG is a is a short-term advisory body convened by the ACMA. It is typically composed of representatives from interested or affected stakeholders, manufacturers, accredited persons, etc. While not having any decision-making powers, it serves an important purpose in providing advice on the development of, or possible changes to, a spectrum or apparatus licence technical framework. Further details on TLGs are available on the [ACMA website](https://www.acma.gov.au/spectrum-licence-technical-liaison-groups). [↑](#footnote-ref-5)
5. ACMA [*Corporate plan 2020–21*](https://www.acma.gov.au/publications/2020-08/report/corporate-plan-2020-21). [↑](#footnote-ref-6)
6. [Radiocommunications (Spectrum Designation—3.4 GHz Band) Notice 2020](https://www.legislation.gov.au/Details/F2020L01661). [↑](#footnote-ref-7)
7. Technical conditions include maximum power, frequency range, out-of-band emissions limits, geographical licence area, and out-of-area emission limits. [↑](#footnote-ref-8)
8. Global mobile Suppliers Association, Member report – 5G Ecosystem report – June 2021. [↑](#footnote-ref-9)
9. Refer to submissions made to the [*Options paper: Optimising arrangements for the 3400–3575 MH band*](https://www.acma.gov.au/consultations/2019-08/optimising-3400-3575-mhz-band-consultation-122019) and the [*Replanning of the 3700–4200 MHz band – Options paper*](https://www.acma.gov.au/consultations/2020-07/planning-options-3700-4200-mhz-band-consultation-222020). [↑](#footnote-ref-10)
10. Refer to submissions made to the [*Options paper: Optimising arrangements for the 3400–3575 MH band*](https://www.acma.gov.au/consultations/2019-08/optimising-3400-3575-mhz-band-consultation-122019). [↑](#footnote-ref-11)
11. For the purposes of this paper, a macro-cell is considered to refer to a base station within a mobile network that provides radio coverage to user terminals over a large area. They are typically characterised by transmitters with high power and high gain antennas with antennas mounted on towers, masts, roof-tops and other existing structures to support wide-area coverage. [↑](#footnote-ref-12)
12. For the purposes of this paper, a restricted cell is considered to be a base station that has some form of restrictions on its operation that limits or reduces the size of the radio coverage to user terminals (e.g., limits on EIRP and antenna heights). It encompasses terms such as micro-cells, small cells, femtocells, etc. [↑](#footnote-ref-13)
13. The studies suggest that a reasonably sized macro cell network could be deployed in Canberra and parts of Sydney. However, such deployments would be difficult in other urban excise areas. They would either be limited to a few discrete locations or not practical to deploy while managing interference into NBN Co services. [↑](#footnote-ref-14)
14. In context of this paper, a restricted-use band refers to a defined frequency range were either no operation is permitted, or operation is only permitted under certain conditions (e.g., agreement between operators). [↑](#footnote-ref-15)
15. For the purposes of this paper, CPEs are defined as fixed, high gain user terminals, typically wall or roof mounted on homes or businesses. They are used to deliver services associated with the NBN. [↑](#footnote-ref-16)
16. For the purposes of thus paper, MS are not considered to operate under NBN Co licences. [↑](#footnote-ref-17)
17. The TLG did not define a percentage of locations to apply this limit. [↑](#footnote-ref-18)