Replanning of the 28 GHz band

Options paper

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Executive summary

This paper represents the next step in planning for the 28 GHz (27.5–29.5 GHz) band. It follows from the [28 GHz spectrum planning](https://www.acma.gov.au/theACMA/spectrum-planning-for-the-28-ghz-band) discussion paperreleased in September 2018. It takes into account feedback provided on the relevant services and applications with interests in accessing the band, international trends and the outcomes from the 26 GHz replanning process. A series of future planning options in the band are identified along with currently preferred options of the Australian Communications and Media Authority (ACMA).

The 28 GHz band is the subject of domestic and international interest for a range of applications including satellite broadband and is at the forefront of global interest in the use of millimetre wave (mmWave[[1]](#footnote-2)) frequencies for terrestrial 5G wireless broadband. The frequency range being considered internationally, in full or part, for 5G encompasses 24.25­­–29.5 GHz. This includes the 26 GHz band (24.25 GHz to 27.5 GHz) that the ACMA has now moved to the replanning stage with the release of the paper [*Future use of the 26 GHz band: Planning decisions and preliminary views*](https://www.acma.gov.au/theACMA/options-for-wireless-broadband-in-the-26-ghz-band).

Due to potential synergies with the 26 GHz band, the ACMA considers it timely to progress its review of arrangements in the 28 GHz band (27.5 GHz to 29.5 GHz) and investigate future planning options for the band by moving it to the preliminary replanning stage.

The ACMA has identified interest in using the 28 GHz band from the following applications/services:

* wide-area wireless broadband (WWB) services, which are deployments traditionally undertaken by large mobile network operators (MNOs) or some fixed telecommunication carriers
* fixed wireless access (FWA) services which refers to smaller, local area subscriber services such as those provided by wireless internet service providers (WISPs) or other dedicated (for example, miners, local government) wireless (generally fixed) broadband networks
* fixed satellite service (FSS) which refers to gateway earth stations and ubiquitous earth stations (fixed earth stations at unknown locations and earth stations in motion (ESIM), typically authorised to operate under a class licence)
* fixed point-to-point services (PTP) which are used by many different services and operators to backhaul data
* high altitude platform stations (HAPS) which operate at altitudes of 20–50 kilometres and are proposed for the provision of broadband services.

This paper analyses the different planning issues for each of the services interested in using the 28 GHz band as well as any sharing and coexistence issues. From this analysis four broad planning options for the band emerged:

* Option 1—wide-area wireless broadband suitable for 5G, PTP, FWA and satellite (both gateway and ubiquitous)
* Option 2—PTP, FWA and satellite (both gateway and ubiquitous)
* Option 3—FWA and satellite (both gateway and ubiquitous)
* Option 4—satellite (both gateway and ubiquitous) only

These four options were assessed against the Spectrum Management Principles to identify preferred options.

In assessing the identified options, the ACMA considered the outcomes of the 26 GHz planning process. These planning outcomes provide arrangements for wide-area terrestrial wireless broadband (for 5G) and some FWA use. Due to the substitutability between the bands, the planning decisions and preliminary views made for the 26 GHz band provide relevant context for the options (and ACMA preferences) identified for the 28 GHz band.

Given that planning decisions in 26 GHz accommodate 2.4 GHz of spectrum suitable for wide area wireless broadband, the ACMA has formed the preliminary views that these applications are adequately catered for in the 26 GHz band.

The ACMA notes that while some provision for local area FWA has been made in 26 GHz, some parts of industry are seeking access to more spectrum (up to 1 GHz) in large population centres across the 26 GHz and 28 GHz bands. In that context, the ACMA sees that there is still likely to be unmet demand for fixed wireless uses in large population centres and is exploring in the various planning options outlined in this paper, the optimal configurations in the 28 GHz band for fixed wireless uses in and around large population centres.

The satellite industry has made strong arguments regarding their existing and future spectrum needs in the 28 GHz band for both gateway and ubiquitous (including earth stations in motion (ESIM)) uses. The ACMA considers these arguments have merit and has reflected this in all options by providing additional spectrum for use by satellite services. Key differences between the options are the amount of spectrum allocated, the location in the band and the level of exclusivity (for example, shared or exclusive access) along with any sharing conditions.

The ACMA also recognises that the 28 GHz band represents the uplink segment of the satellite Ka band, so any change in arrangements would have implications for use of the associated downlink segment (17.7–20.2 GHz). While formal consideration of arrangements for the downlink segment are not within scope of this paper, the need or otherwise to perform this work has been identified for each relevant option. The ACMA expects to undertake further work on the associated downlink segment, when the scope of any changes required for the uplink segment are clear.

PTP services represent a small but significant set of incumbent interests in the 28 GHz band.  The options explored in the paper acknowledge the continuing need for supporting PTP services with wide channel bandwidths.  The preferred options identified by the ACMA consider whether future PTP services growth is best supported in the 28 GHz band or if it can be adequately supported in other bands.

To inform a decision on this issue, the ACMA will consult with industry on introducing new PTP channel arrangements to the 38 GHz band. This consultation will be conducted in Q2 2019. In the event an option is adopted that no longer supports new PTP licences in the 28 GHz band, the ACMA considers that existing licensed PTP users could continue to operate under the current arrangements for a defined period of time (i.e. be ‘grandfathered’)—the period and conditions applicable is something that the ACMA is seeking feedback on in this paper.

While high altitude platform stations (HAPS) have been identified as a possible application in 28 GHz band, based on the interest and evidence supplied so far, the ACMA is not contemplating use of the band by HAPS at this time. Furthermore, WRC-19 agenda item 1.14 is still investigating additional identifications for HAPS in a variety of bands. Moving forward the ACMA will continue to monitor international and domestic developments for HAPS, including the outcomes of WRC-19, in the 28 GHz and other bands. Consideration of possible arrangements for HAPS will be progressed under a separate consultation process as demand and spectrum options become more certain.

Considering the preliminary views above, the ACMA has identified Options 2 and 3 as its preferred options for the 28 GHz band. Both options provide additional spectrum for FWA and satellite usage, with the key difference being whether future PTP services are accommodated in the band. Feedback on the issues presented in this paper will help inform which identified option or variant best meets the objective of maximising the overall public benefit from use of the band.

# Issues for comment

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

Specific questions are featured in the relevant sections of this paper and collated below. Details on making a submission can be found in the *Invitation to comment* sectionat the end of this document*.*

1. **Do stakeholders have comments or further views on the services and planning issues discussed for the 28 GHz band?**
2. **If a decision was made to remove 28 GHz PTP arrangements, what is the minimum appropriate length of time to grandfather existing PTP licences?**
3. **Are there any other conditions that should be considered for PTP grandfathering?**
4. **Are there any other technical issues the ACMA should consider regarding the ability for WWB, FWA, PTP and FSS to share or coexist in the 28 GHz band?**
5. **Do stakeholders have comments on any of the options proposed in this section or other options to propose?**
6. **Is the definition of ‘large population centres’ (as described in Appendix A), suitable for application in Options 1a, 1b, 2 and 3?**
7. **Do stakeholders have any comments on the assessment of each option against the Spectrum Management Principles?**
8. **Is there any relevant evidence that provides an indication of the value the WWB sector places on additional spectrum in the 28GHz band?**
9. **Is there any relevant evidence that provides an indication of the value the FWA sector places on additional spectrum in this band?**
10. **What value do PTP operators place on having access to 112 MHz channels? If similar arrangements could be implemented in the 38 GHz band, would they be a suitable replacement for the 28 GHz band?**
11. **Is there any evidence that provides an indication of the value the PTP sector places on maintaining access to this band?**
12. **Is there any evidence that provides an indication of the value the FSS sector places on access to this band?**
13. **The ACMA invites comment on its currently preferred options. Should other options be considered?**

# Introduction

## Purpose of this paper

In September 2018, the ACMA released a [discussion paper](https://www.acma.gov.au/theACMA/spectrum-planning-for-the-28-ghz-band) identifying domestic and international considerations for the 27.5–29.5 GHz (28 GHz) band, and invited comment on possible changes in planning arrangements for the band. The consultation closed in November 2018, with 24 submissions being received. An outcome of the September 2018 paper is that the ACMA has progressed consideration of the 28 GHz band to the ‘preliminary replanning’ stage of its planning process.

This paper presents the next step in the ACMA’s consultation process for reviewing arrangements in a band[[2]](#footnote-3). It presents high-level options for replanning and allocating services in the 28 GHz band, taking into account information received in submissions to the September 2018 paper and the outcomes of the 26 GHz band review process. Options have also been assessed against the ACMA’s Spectrum Management Principles. This was done to determine which option or options best satisfies those principles and inform the ACMA’s preferred way forward.

Comment is invited on the options, including preferred options, presented in this paper to inform possible progression of the 28 GHz band to the ‘replanning’ stage.

## Legislative and policy environment

Managing spectrum efficiently and effectively for the benefit of all Australians is a key priority for the ACMA[[3]](#footnote-4). The ACMA draws on a range of legislative and administrative tools and overarching guidance in executing these functions.

### Guiding legislation

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

* manage the radiofrequency spectrum in accordance with the Act

advise and assist the radiocommunications community.

Consistent with the spectrum management functions set out in the ACMA Act, the object of the *Radiocommunications Act 1992* (the Act) is to provide for management of the radiofrequency spectrum in order to (among other goals):

* maximise—by ensuring the efficient allocation and use of the spectrum—the overall public benefit derived from using the radiofrequency spectrum
* provide a responsive and flexible approach to meeting the needs of spectrum users

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

* support the communications policy objectives of the Commonwealth Government.

The decisions and undertakings set out in this paper are consistent with these goals. Specifically, regarding the latter goal, enabling access to the band for both terrestrial and satellite wireless broadband services falls in line with a number of key government policy objectives, including:

* promoting sharing, enhancing delivery of fast broadband services
* promoting the efficient use of spectrum through optimising its use

fostering competitive telecommunications markets by providing alternative delivery mechanisms for ultra-fast broadband.

### Principles for spectrum management

The ACMA is also guided by the [*Principles for Spectrum Management*](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/principles-for-spectrum-management) (the Principles), which are:

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

The ACMA adheres to the object of the Act and the Principles through a balanced application of market and regulatory mechanisms. Figure 1 describes the ACMA’s general approach to spectrum management decision-making. Consideration of the 28 GHz band was first foreshadowed in the ACMA’s *Five-year spectrum outlook 2016–2020* (see below). In terms of the general approach, the release of this paper fits within the ACMA’s broad public consultation ‘filter’. The ACMA will continue to apply the elements of its spectrum management decision framework, including the spectrum management principles, as it considers the responses to this paper.

1. Spectrum management decision framework

Spectrum management decision framework

### Existing licensing regimes

There are currently three licence types available to authorise access to spectrum—spectrum, apparatus and class licences. Note that this will change if the proposed new spectrum management legislation comes into effect (see below).

An apparatus licence authorises the use of a radiocommunications device (or group of devices) operating under a particular radiocommunications service type, in a particular frequency range, and at a particular geographic location[[4]](#footnote-5) for a period of up to five years. It is typically issued ‘over-the-counter’ in accordance with coordination rules developed by the ACMA.

A spectrum licence authorises the use of a particular frequency band within a particular geographic area for a period of up to 15 years under the current legislative framework. The geographic area can vary in size and can comprise the entire country. Spectrum licences have historically been utilised for the majority of bands used to deploy commercial mobile networks.

An inherent feature of spectrum licensing is technological flexibility—that is, the licensing rules, while usually optimised for an expected technology, generally specify only generic technical detail and limitations[[5]](#footnote-6), while not expressly mandating a particular type of technology or service. This allows a licensee to deploy any technology as long as it complies with the terms and conditions of the licence, without intervention from the regulator. It is up to the licensee to manage interference between devices, although the adoption of international standards mitigates the potential for interference between devices. Spectrum licences are more conducive to spectrum trading than apparatus licences, due to design features such as their longer and more certain tenure and their ability to be sub-divided.

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

## Issues not within the scope of this paper

The purpose and scope of this paper is outlined above. The following issues are not within the scope of this paper:

Apparatus tax arrangements

A review of the apparatus licence tax arrangements that apply to different services is not within scope of this paper. The ACMA is seeking feedback from industry on its general review of apparatus licence taxes as part of the consultation on its annual work program, the [five-year spectrum outlook](https://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/5-Year-Spectrum-Outlook/five-year-spectrum-outlook) (FYSO). Interested parties are invited to provide the views on apparatus licence taxes in the 28 GHz band as part of this process.

Detailed licensing and allocation options

Detailed licensing and allocation options will be considered as part of any possible re-farming process after a suitable planning option is determined.

Other mmWave bands

The sole focus of this paper is the 28 GHz band. The potential future use of other mmWave bands such as the 26 GHz, 40 GHz and 60 GHz bands is outside the scope of this paper.[[6]](#footnote-7) Respondents will be able to contribute views on the relative priorities of other bands through the [FYSO](https://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/5-Year-Spectrum-Outlook) process.

Engagement in international activities

International developments and activities are relevant to domestic considerations. In the case of the 28 GHz band, the ACMA, along with other domestic stakeholders, is closely involved in and monitoring studies being carried out in the ITU-R under WRC-19[[7]](#footnote-8) agenda item 1.5 and 1.14 on mmWave bands for ESIM[[8]](#footnote-9) and HAPS[[9]](#footnote-10) respectively. Where appropriate, the outcome of these studies and other international developments associated with these WRC-19 agenda items have been used to help inform ACMA views in the 28 GHz band*.*

However, the scope of this paper does not extend to Australian strategies or positions on WRC-19 agenda items. These matters are dealt with separately through relevant ACMA and Department of Communications and the Arts (DoCA)-led preparatory processes. Stakeholders interested in these processes can get more information from the [ACMA website](http://www.acma.gov.au/theACMA/international-telecommunications-activities) or by contacting either the ACMA’s International Radiocommunications Section ([IRS@acma.gov.au](mailto:IRS@acma.gov.au)) or DOCA’s International Radiocommunications Section ([WRC@communications.gov.au](mailto:WRC@communications.gov.au)).

## Next steps

Table 1 provides a notional timeline and milestones associated with the 28 GHz band review process.

Importantly, whether the notional timeline is achievable and/or appropriate is contingent on a variety of factors including feedback received from stakeholders.

1. Indicative timeline for progressing consideration of the 28 GHz band

| Stage | Milestone | Date |
| --- | --- | --- |
| **Stage 2— Preliminary replanning** | Release: *Replanning of the 28 GHz band: Options paper* | April 2019 |
| Submissions due to options paper | 17 May 2019 |
| Release: Discussion paper on new point-to-point channel arrangements for the 38 GHz band | May/June 2019 |
| Release: decision paper and preliminary views paper for the 28 GHz band | Q3 2019 |
| **Stage 3— Re-farming** | Commencement of *re-farming* stage, if applicable | Q4 2019 |

# The process to date

## Consultation

On 27 September 2018, the ACMA released the [28 GHz discussion paper](https://www.acma.gov.au/theACMA/spectrum-planning-for-the-28-ghz-band). The paper sought industry view on the potential uses of the entire 28 GHz (27.5–29.5 GHz) band considering the latest international trends.

The discussion paper provided an overview of usage of the band at the national level and an overview of international trends. The ACMA asked stakeholders to identify their interest in making use of the 28 GHz band and to provide their views on three specific questions:

1. How much spectrum is required to provide the service?
2. Is there a clear geographical delineation—for example, metropolitan or regional for the service?

Is there or will there be readily available equipment for the service?

The following ‘Summary of submissions’ section contains responses to this consultation process.

## Summary of submissions

The ACMA received 24 submissions to the discussion paper. Full submissions to the consultation process can be found on the [ACMA’s website](https://www.acma.gov.au/theACMA/-/media/AF3D0BB2F7BB456EB073DD48F1C0FB00.ashx). The main applications/services identified in submissions as interested in using the 28 GHz band were:

* wide-area wireless Broadband (WWB) services which are deployments traditionally undertaken by large mobile network operators (MNOs) or some fixed telecommunication carriers
* fixed wireless access (FWA) services which refers to smaller, local area subscriber services such as those provided by wireless internet service providers (WISPs) or other dedicated (e.g. miners, local government) wireless (generally fixed) broadband networks
* fixed satellite service (FSS) which refers to gateway earth stations (FSS gateways) and ubiquitous earth stations (fixed earth stations at unknown locations and earth stations in motion (ESIM), typically authorised to operate under a class licence)
* fixed point-to-point services (PTP) which are used by many different services and operators to backhaul data
* high altitude platform stations (HAPS) which operate at altitudes of 20-50 km and are proposed for the provision of broadband services.

FWA

The ACMA received three submissions that provided comment on FWA applications.

**Spectrum requirements**

Only one submission provided an indication of the required spectrum for FWA. The submission indicated that up to 1 GHz of spectrum should be provided for FWA services.

All three submissions indicated that either 100 MHz (for proposed 5G equipment) or 112 MHz (for existing FWA equipment) channel widths are required to provide effective FWA services.

Geographical delineation

Two of the submissions indicated that the expected deployment of FWA would be predominantly in urban and suburban locations. One submission indicated that FWA should not be constricted to any location and should be considered on an Australia wide basis.

Equipment availability

All three submissions indicated that equipment is readily available for the 28 GHz band.

Sharing capability

Two of the submissions indicated that FWA should be able to share with other services, in particular PTP services, in a coordinated manner.

Licensing arrangements

Two of the submissions preferred site-based apparatus licensing arrangements where possible. One submission suggested considering dynamic spectrum licensing management where possible.

Fixed satellite services (FSS)

The ACMA received nine submissions that provided comment on FSS applications.

**Spectrum requirements**

Six of the submissions supported the whole band being allocated to FSS on an exclusive basis for both gateway and ubiquitous FSS earth stations. One submission only supported the allocation of 27.5 - 29.1 GHz for such use.

Geographical delineation

Eight responses indicated that the whole of Australia should be considered for use by the FSS, in particular, for ubiquitous FSS earth stations. Due to the nature of ubiquitous FSS earth stations (particularly mobile earth stations), it was argued that restricting use to particular areas would not be practical.

Equipment availability

All submissions indicated that equipment is readily available for the 28 GHz band for both gateway and ubiquitous FSS earth stations, and equipment is being developed to support new FSS systems.

Sharing capability

All nine submissions rejected any sharing possibilities with mobile broadband services. The submissions referred to technical studies undertaken for this scenario as well as the difficulty in managing interference between services that include ubiquitously deployed and mobile user terminals operating in the same area. One submission indicated their belief that it is feasible for FSS to share with fixed broadband. Another submission suggested putting in place an embargo on new PTP services in this band.

Licensing arrangements

Most submissions supported the existing licensing arrangements for gateway earth stations and extending class licence arrangements to support ubiquitous FSS earth stations across the entire 28 GHz band.

Additional comments

A common theme of all the submissions supporting FSS was that no further provision of spectrum should be made for WWB. Three reasons were provided to support this:

* co-existence between ubiquitous FSS earth stations and WWB in the same geographical area is technically impossible;
* WWB already has enough spectrum in frequency bands below 6 GHz as well as in other mmWave bands being considered for mobile broadband (including the 26 GHz band). Hence there is no reason to consider the 28 GHz band for WWB and restrict other services; and

there has already been significant investment by the satellite industry in the 28 GHz band.

### Area wide WWB

The ACMA received seven submissions that provided comment on area wide WWB. All submissions identified 5G as the intended technology standard to be considered for this band at this point in time.

**Spectrum requirements**

All seven submissions supported an allocation being made available from 27.5 GHz to 28.35 GHz for area wide WWB. Four of these submissions also supported an allocation for area wide WWB in the 28.35-29.5 GHz frequency band. While one also supported an allocation in the 28.5 GHz to 29.1 GHz frequency range.

Geographical delineation

Six responses provided feedback on geographical options for area wide WWB. All the responses indicated that the focus would be in metropolitan areas to begin with and five of the submissions indicated regional hotspots should be considered for expansion in the future. Two submissions indicated support for an Australia-wide allocation.

Equipment availability

All submissions indicated that equipment would be readily available for the 28 GHz band for 5G services.

Sharing capability

One submission supported sharing between area wide WWB and FSS gateways communicating with satellites in the geostationary orbit (GSO). However, they believed further study is required to determine compatibility with FSS gateways communicating with satellites in non-GSO. Three submissions believe that sharing between ubiquitous FSS and WWB could be feasible with different combinations of appropriate band segmentation, geographical segmentation (e.g. limiting ubiquitous FSS earth stations to regional/remote areas) and defining appropriate protection levels.

Licensing arrangements

All submissions supported licensing arrangements that would provide exclusive use of the spectrum in major population areas, i.e. spectrum licensing. Three submissions proposed apparatus licensing of areas outside major populations.

### Fixed PTP

The ACMA received two submissions that provided comment on PTP applications.

**Spectrum requirements**

Both submissions supported maintaining the existing spectrum allocation for PTP services.

Geographical delineation

One submission identified that the propagation characteristics of the 28 GHz band will limit the distance that can be covered by a PTP service. Considering these limitations, the submission suggested that fixed PTP in this band will only be viable in urban and suburban areas. The other submission indicated that deployment of PTP services will be constrained to urban and suburban areas of major cities as well as large population centres in rural areas.

Equipment availability

Both submissions indicated that PTP equipment is readily available in for the 28 GHz band.

Sharing capability

Only one submission commented on the sharing capabilities of PTP services. The view expressed was that coexistence with non PTP services requires conservative criteria and leads to inefficient use of spectrum.

Licensing arrangements

One submission expressed the view that the current licensing fees are extremely high and should be reduced. The submission suggested looking at alternative solutions, for example class licensing or discounting single users, to help improve the take up of this band for PTP services.

### Other submissions

The ACMA received two submissions that provided comment on other applications that should be considered in this band.

The submission from the Department of Defence indicated that while they do not have any immediate plans, this may change in the future so they do not support exclusion of FSS systems from all, or portions of, the 28 GHz band*.*

One submission highlighted the WRC-19 agenda item 1.14 currently under consideration. In the 28 GHz band, the frequency range 27.9 GHz to 28.2 GHz may be used by HAPS in the HAPS-to-ground direction in 23 countries in Regions 1 and 3. Australia is not currently part of these arrangements. The submission indicated that access to the 27.9–28.2 GHz band should be considered in the replanning of the band should Australia be included in international arrangements for HAPS.

# Consideration of planning issues

In determining and assessing possible options for the 28 GHz band the following issues have been considered:

* the outcomes of the [*Future use of the 26 GHz band: Planning decisions and preliminary views*](https://www.acma.gov.au/theACMA/options-for-wireless-broadband-in-the-26-ghz-band)
* spectrum arrangements for services in the band or with an interest in gaining access to the band, including WWB, PTP, FWA, FSS (both gateway and ubiquitous earth stations) and HAPs.

These issues are discussed further below.

1. **Do stakeholders have comments or further views on the services and planning issues discussed for the 28 GHz band?**

## Outcome of 26 GHz band replanning process

Following a period of consultation, technical studies and engagement within international forums, the ACMA released the *Wireless broadband in the 26 GHz band—Options paper* in September 2018. The outcomes of this consultation have been released in parallel to this discussion paper and are detailed in the paper [*Future use of the 26 GHz band: Planning decisions and preliminary views*](https://www.acma.gov.au/theACMA/options-for-wireless-broadband-in-the-26-ghz-band).

A summary of the proposed arrangements for the 26 GHz band is illustrated in Figure 2, this includes:

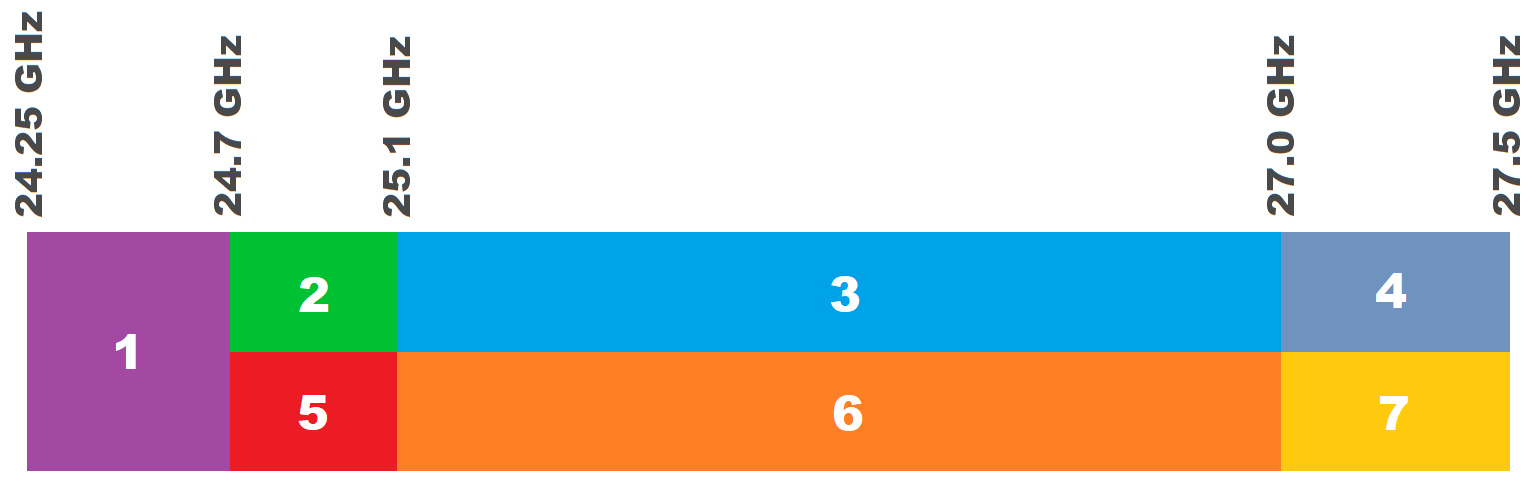
24.25–24.7 GHz—class licensed access for wireless broadband limited to private property and restricted to indoor use only (Australia-wide);

24.7–25.1 GHz—apparatus licensing, potentially using a new ‘spectrum-space’ apparatus licence type[[10]](#footnote-11) (suitable for FWA use) and co-frequency class licensing (indoor and outdoor use) limited to private property for wireless broadband (Australia-wide);

25.1–27 GHz—spectrum licensing for WWB in defined areas (referred to as large population centres in this paper and detailed in *Appendix A*). Apparatus licensing, (potentially using a new spectrum-space apparatus licence type (suitable for FWA use), if the ACMA is able to determine such a licence type), for wireless broadband elsewhere. Existing Space Research Service (SRS) earth stations in the range 25.5-27 GHz will be able to continue to operate with proposed licence conditions included on new wireless broadband licences to ensure coexistence.[[11]](#footnote-12) New SRS earth stations (if any) may also be permitted on a first-in-time coordinated basis outside of large population centres; and

27–27.5 GHz—same as 25.1–27 GHz but with additional proposed licence conditions applied to wireless broadband licences within NBN Co satellite gateway uplink footprints. Existing FSS gateways can continue to operate in the band. New FSS gateways may also be permitted on a first-in-time coordinated basis outside of large population centres (this relates to areas proposed for spectrum licensing).

1. Proposed wireless broadband arrangements for the 26 GHz band



* Class-licensing for indoor wireless broadband use – Australia-wide
* Class-licensing for indoor and outdoor wireless broadband use – Australia-wide
* Spectrum licensing – inside large population centres. Includes additional conditions to protect SRS earth stations.
* Spectrum licensing – inside large population centres. Includes arrangements to protect existing FSS uplinks
* Apparatus licensing for wireless broadband use – Australia-wide
* Apparatus licensing for wireless broadband use – outside large population centres. Includes additional conditions to protect SRS earth stations
* Apparatus licensing for wireless broadband use and FSS uplinks on a first-in-time coordinated basis – outside large population centres

## Consideration of spectrum options for WWB

A wide range of views were expressed in submissions about future use of the 28GHz band for WWB.

To assess the merits of a potential allocation for WWB in the 28 GHz band, the ACMA has considered the following evidence:

* international trends
* domestic spectrum provisions for WWB in the 26 GHz band
* other mmWave spectrum options being considered for WWB under WRC-19 agenda item 1.13.

Internationally, there has been no change to the information on proposed arrangements in other countries or to international trends in the 28 GHz band since the release of the [September 2018 consultation paper](https://www.acma.gov.au/theACMA/spectrum-planning-for-the-28-ghz-band). As such, the information detailed in that paper has been used to inform the development of options. In line with WRC-19 agenda item 1.13, many countries are considering or have decided to allocate spectrum in the 26 GHz band for WWB. The USA, Korea and Japan have continued with their allocation in both the 26 GHz and 28 GHz bands for WWB as previously indicated. This suggests a viable equipment ecosystem will develop across the entire 24.25–29.5 GHz frequency range.

As a result of the 26 GHz band process, the ACMA will shortly commence work towards facilitating 2.4 GHz of spectrum for issue via spectrum licences in large population centres. This is expected to be of primary interest to operators wishing to deploy WWB services and is a significant amount of spectrum. In addition, the ACMA will work towards providing 2.4 GHz of apparatus licensed spectrum outside of large population centres and another 400 MHz of apparatus licensed spectrum Australia-wide for localised wireless broadband deployments. These arrangements are also expected to be of interest to WWB operators.

Under WRC-19 agenda item 1.13, numerous other mmWave bands are also being considered for WWB. This could result in the identification of significant amounts of additional spectrum for WWB beyond the 26/28 GHz band. In particular, there is strong interest internationally and domestically in identifying all or part of the 37–43.5 GHz band as well as the 66–71 GHz bands for WWB. Europe has signalled that, in addition to the 26 GHz band, it “considers the bands 40.5–43.5 GHz and 66–71 GHz have good potential for future harmonisation in Europe”[[12]](#footnote-13). The USA has also announced plans to auction the 37.6–38.6 GHz, 38.6–40 GHz and 47.2–48.2 GHz frequency ranges in 2019[[13]](#footnote-14), and has already released arrangements for unlicensed use of the 66–71 GHz band.

The ACMA recently consulted on class licensed arrangements in the 66–71 GHz band to support 5G and other data communication systems[[14]](#footnote-15). Submissions to this process are currently being reviewed. The 37–43.5 GHz band is currently in the monitoring stage of the ACMA’s process for considering new spectrum for wireless broadband.

## Consideration of spectrum options for PTP

There is 336 MHz of paired spectrum available for PTP use in the 28 GHz band. While arrangements for PTP in the band include channel bandwidths of 28 MHz, 56 MHz and 112 MHz, the majority of licences use 112 MHz channels. Proponents of PTP use in the band (see ‘Summary of submissions’) expressed the desire to maintain existing arrangements in this band due to the 112 MHz channel sizes that are unavailable elsewhere. These channels are used to support backhaul for high data rates services. Proponents of other services suggested that given the limited number of PTP assignments, spectrum requirements for PTP could be accommodated in other bands, and the spectrum made available for other services such as FSS and WWB.

As of 5 March 2019, there were 22 PTP licences held by 11 licensees in the 28 GHz band. Licences are mainly held by local councils and WISPs. Due to the current limited usage of the 28 GHz PTP arrangements the ACMA has investigated whether arrangements in other bands would be sufficient to accommodate future growth and demand for PTP use. This included consideration of existing arrangements in the following bands nearby in frequency: 18 GHz, 22 GHz, 31 GHz and 38 GHz. Table 2 summarises arrangements and existing use in these bands.[[15]](#footnote-16) The assessment was based on whether these PTP bands could support new services in 28 MHz, 56 MHz and 112 MHz channel bandwidths currently defined in the 28 GHz band.

Review of Table 2 indicates there are arrangements in place in the 18 GHz and 22 GHz bands to support 28 MHz and 56 MHz channels. Comparison of the number of assignments in the 18 GHz and 22 GHz bands also suggest there is reasonable room for growth in the 22 GHz band. In addition, the lower frequency of the 18 GHz and 22 GHz bands ensures that similar or larger path lengths should be achievable when compared to the 28 GHz band. It is also noted there are also options for 28 MHz channels in the 38 GHz band.

Unfortunately, there are no equivalent arrangements in place in other bands to support the larger 112 MHz channels available in the 28 GHz band. For this reason, the ACMA has also investigated options to introduce channel bandwidths larger than 100 MHz into existing PTP bands. The 18 GHz and 22 GHz bands were deemed unsuitable as there are already a large number of assignments which would restrict the availability of any channels greater than 100 MHz in bandwidth. The 31 GHz band is deemed unsuitable as it is not large enough to provide multiple channels greater than 100 MHz. However, the 38 GHz band could be considered an option as it has enough spectrum to accommodate multiple paired 112 MHz channels. Also based on the current level of use, it appears to have sufficient capacity to supports new assignments.

It is acknowledged that the 38 GHz band will not support the same maximum path lengths as 28 GHz. However, the difference does not appear to be significant and it is expected that most intended path lengths could be accommodated in the 38 GHz band. For example, the current maximum path lengths for licences in the 28 GHz and 38 GHz bands are 8.9 km and 6.6 km respectively, while the average path length in the 28 GHz band is 3km. This average distance is expected to be an achievable within the 38 GHz band, while some longer distances may require multiple hops.

1. Summary of 18 GHz to 50 GHz point to point bands

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Band (GHz) | Frequency Range (GHz) | Channel bandwidths supported that are >25 MHz (MHz) | Number of channel pairs for each channel bandwidth supported | Number of assignments |
| 18 | 17.7–19.7 | 27.5, 55 | 10, 5 | 16860 |
| 22 | 21.2–23.6 | 28, 56 | 11, 5 | 4314 |
| 28 | 27.5–29.5 | 28, 56, 112 | 12, 6, 3 | 72 |
| 31\* | 31.0–31.3 | 25, 50 | 6, 3 | 0 |
| 38 | 37.0–39.5 | 28 | 10 | 1124 |

*Note: source of data from RRL as at 1 February 2019*

\* no new assignments are allowed in this band.

In determining if the 38 GHz band is a viable option for supporting wider PTP channels, the ACMA investigated whether there were international harmonised arrangements for 112 MHz channel bandwidths in the band and performed a scan for equipment availability.

ITU-R Recommendation F.749 specifies a harmonised channel plan for PTP in the 36–40.5 GHz band. This recommendation provides arrangements for 3.5, 7, 14, 28, 56, and 112 MHz channel bandwidths. CEPT[[16]](#footnote-17) Recommendation T/R 12-01 defines the same channel plan. These plans provide for up to 10 paired 112 MHz channels within the 38 GHz band. The following two reports from CEPT are also relevant:

ETSI TS 101 785: "Fixed Radio Systems; Point-to-point equipment; Parameters for packet data radio systems for transmission of digital signals operating in the frequency range 23, 26, 28 or 38 GHz";

ETSI EN 301 785 V1.1.1 (2001-02) “European Standard (Telecommunications series) Fixed Radio Systems; Point-to-point equipment; Parameters for packet data radio systems for transmission of digital signals operating in the frequency range 23, 26, 28 or 38 GHz”.

The ACMA has also been able to identify at least two companies that provide equipment with 112 MHz channel capability for PTP in the 38 GHz band.

When considering whether the 38 GHz band is suitable long-term option for wide bandwidth PTP channels, it is important to note that all or part of the 37–43.5 GHz band is being considered internationally for WWB. When assessing options for WWB, the ACMA will take into account any existing and planned use of the 37–40.5 GHz portion of the band. This includes use by PTP as well as other stakeholders (including Defence and the satellite industry). This includes consideration of the long-term benefits of such use and whether WWB use of the adjacent 40.5–43.5 GHz frequency range (which is currently unused) would be more appropriate.

The ACMA intends to further investigate the inclusion of a 112 MHz channel arrangements into the 38 GHz band. This will be done in a separate discussion paper to be released in Q2 2019. The ACMA considers that a decision on the viability of the band can be made by early Q3 of 2019 and inform decisions made for the 28 GHz band. In the event that 38 GHz is considered a viable band for PTP services requiring channel bandwidths above 100 MHz, the ACMA will be able to investigate different planning options in the 28 GHz band. For example, it may be possible to cease support for new 28 GHz PTP services to create additional flexibility in replanning options for the band.

If a decision is made to cease support for new 28 GHz PTP services, the ACMA would grandfather existing PTP licences for a minimum period of time. During this period PTP licence would be provided ongoing protection provided no significant changes are made to the technical characteristics of their systems. The ACMA is seeking industry input in determining an appropriate minimum period of time for the grandfathering arrangements to apply for. This should provide a reasonable period of time for licensees to recoup their investment (for example, seven years). Depending on developments in the 28 GHz band, the ACMA could change arrangements for grandfathered PTP licences at any point after this period ends.

1. **If a decision was made to remove 28 GHz PTP arrangements, what is the minimum appropriate length of time to grandfather existing PTP licences?**
2. **Are there any other conditions that should be considered for PTP grandfathering?**

## Consideration of spectrum options for FWA

One of the outcomes from the [Future use of the 3.6 GHz band](https://www.acma.gov.au/theACMA/future-approach-to-the-3_6-ghz-band) process was that the ACMA committed to investigating the possibility of apparatus licensed point-to-multipoint arrangements in part of the 28 GHz band to support wireless internet service providers (WISPs) and other prospective site-based wireless broadband operators. One respondent to the consultation indicated in the order of 800 MHz to 1 GHz is preferred for FWA use, to support multiple operators and allow operators to provide a competitive service.

One of the planning outcomes of the 26 GHz band process is to make a total of 2.8 GHz of apparatus licensed spectrum for wireless broadband use outside of large population centres. However, only 400 MHz of apparatus licensed spectrum is planned for wireless broadband use within large population centres. Recognising the preference from FWA proponents to have access to the order of 800 MHz to 1 GHz of spectrum, further consideration should be given to the identification of additional 400–600 MHz of spectrum for FWA only use within large population centres, as defined in Appendix A, in the 28 GHz band.

The ACMA has identified two possible options for additional FWA spectrum in the 28 GHz band:

* If the arrangements for PTP services are retained in the 28 GHz band, FWA could share the spectrum allocation on a co-primary basis. This would make up to six additional 112 MHz (or 100 MHz) channels available for FWA use;

If the arrangements for PTP services are not retained in the 28 GHz band, FWA could be identified in a dedicated block of spectrum at the lower end of the band. This would minimise the number of frequency boundaries (which introduce inefficiencies) shared with other services, such as the FSS. An allocation in the order of 400-600 MHz would provide FWA operators access to a total of 800–1000 MHz of spectrum across the 26 GHz and 28 GHz bands in large population centres.

## Consideration of spectrum options for FSS

Access to sufficient spectrum is a critical component to meet the capacity requirements of new broadband satellite systems. As the capacity requirements for terrestrial mobile broadband services continues to grow, so too do the capacity requirements for satellite broadband and other services delivered via satellite. This is reflected by the increasing number of high-throughput satellite (HTS) and very high-throughput satellite (VHTS) systems either being deployed or in development. Access to spectrum in the Ka band (which includes the 17.7–20.2 GHz frequency range for downlinks and the 27–30 GHz frequency range for uplinks) is important for these satellite systems due to the large amount of spectrum available and the increasing level of congestion in lower frequency bands.

While this paper focuses on a portion of the Ka band used for FSS uplinks, it is important to acknowledge there is also a relationship with the downlink segments. For example, any change in arrangements for ubiquitous FSS earth stations (ubiquitous FSS) in the 28 GHz band would logically have implications for similar use in the downlink segment. Formal consideration of arrangements for FSS in the downlink segment of the Ka band is not within scope of this consultation paper. This is because it requires detailed assessment of the spectrum in question and associated incumbent services. However, the ACMA expects to undertake further work on the associated downlink segment, when the scope of changes required for the uplink segment are clear.

In Australia, the FSS currently uses the 28 GHz band for a combination of FSS gateways (across the entire band) and ubiquitous FSS (currently limited to the 28.5–29.1 GHz segment of the 28 GHz band – noting that 29.5–30 GHz is also available for ubiquitous FSS, but which is outside of scope of the 28 GHz band review).

FSS gateways form an important part of any satellite system for data backhaul. As of the 5 March 2019 there were 68 FSS gateway licences operating at 21 locations in Australia, most of these belonging to NBN Co. This number is expected to increase as the satellite industry deploy more services. For example, Viasat has announced it is considering Australia to host the infrastructure (including FSS gateways) for its next generation satellite[[17]](#footnote-18). This would require the deployment of hundreds of earth stations along the east coast of Australia and access to most, if not all, of the 28 GHz band at each site. Other satellite operators, such as OneWeb, have also expressed interest in deploying new FSS gateways in Australia that require access to the most, if not all, of the 28 GHz band.

To cater for the needs of next generation satellite systems, the ACMA has developed options in this paper that provide access to the entire 28 GHz band for existing and new FSS gateways, particularly in regional and remote areas. All options also ensure that existing FSS gateways can continue operating in the band.

Ubiquitous FSS use of the 28 GHz band can be divided into two types: fixed and mobile (typically referred to as earth stations in motion (ESIM)). Ubiquitous FSS is supported by apparatus/class licensing arrangements in the 28.5–29.1 GHz (and 29.5-30 GHz) segment of the 28 GHz band. It is used extensively by NBN Co as part of their Sky Muster satellite network which provides broadband access to the Australian public in regional and remote areas. NBN Co’s submission to the September 2018 paper indicated the use of the current 600 MHz of class licensed spectrum is intensive and is expected to increase over time. To meet this demand and provide certainty for the design of future satellites, NBN Co stated that access to the entire 28 GHz band is required. This sentiment was supported by the joint submission from the Asia-Pacific Satellite Communications Council, Asia Video Industry Association, Global VSAT[[18]](#footnote-19) Forum and EMEA[[19]](#footnote-20) Satellite Operators’ Association to the September 2018 paper (which extended to consideration of ESIM as well). The joint submission also pointed out that some satellite operators were planning to move the operational frequency of their gateways to the 40/50 GHz band to provide more spectrum in the 28 GHz band to accommodate demand for ubiquitous FSS.

ESIM networks include the provision of services to aeronautical, maritime and terrestrial terminals. ESIM use is currently supported under class licensing arrangements in Australia for both NGSO[[20]](#footnote-21) and GSO[[21]](#footnote-22) systems. Supported ESIM frequency bands are the same as those for fixed earth stations as provided for in the [Communications with Space Objects Class Licence](https://www.legislation.gov.au/Series/F2015L01486). That is, earth station transmitters in the 28.5–29.1 GHz and 29.5–30 GHz bands and earth station receivers in the 17.7–18.2 GHz, 18.8–19.3 GHz, 19.7–20.2 GHz bands [[22]](#footnote-23). ESIM NGSO use and ESIM GSO use of 28.5-29.1 GHz 17.7–18.2 GHz and 18.8–19.3 GHz bands is under interim arrangements to be reviewed pending the outcomes of the WRC-19. WRC-19 agenda Item 1.5 is considering a further identification for ESIM in the 17.7–19.7 GHs and 27.5–29.5 GHz bands. Such an identification would further assist in providing global economies of scale for use and equipment in the band. While Australia supports the development of appropriate technical and operational requirements to facilitate ESIM use internationally, no decision has been made regarding domestic use of the 17.7–19.7 GHz and 27.5–29.5 GHz bands.

Given the mobile nature of these services, unless exclusive access to spectrum is given for FSS use, measures to manage interference with other services needs to be considered. While aeronautical and maritime services could, if required, use techniques such as ceasing operation at defined separation distance (or altitude) to help mitigate interference with other services, it is unlikely to be practical for terrestrial ESIM to operate in the same geographical area as WWB or FWA services. It is acknowledged that satellite operators would prefer no limitations on the geographical or in frequency operation of ESIM as it increases complexity of service delivery and may deny access to some areas. However, this needs to be balanced against the spectrum needs of other services.

Noting the level of international interest, development of new satellite systems and the likely emergence of an ESIM ecosystem in this band internationally, the ACMA is of the view that options for both fixed ubiquitous FSS and ESIM should be considered in the 28 GHz band.

## Consideration of spectrum options for HAPS

WRC-19 agenda item 1.14 is considering additional identifications for HAPS both regionally and on a global basis. This includes options for deletion or modification of **No 5.537A** of the ITU-R Radio Regulations (RR), which currently identifies the 27.9–28.2 GHz frequency range for use by HAPS in a number of countries. Australia is not currently part of **No 5.537A** of the RR and is still considering its position on this agenda item.

While High Altitude Platform Stations (HAPS) have been identified as a possible application in 28 GHz band, based on the interest and evidence supplied so far, the ACMA is not contemplating use of the band by HAPS at this time. Furthermore, WRC-19 agenda item 1.14 is still investigating additional identifications for HAPS in a variety of bands. Moving forward the ACMA will continue to monitor international and domestic developments for HAPS, including the outcomes of WRC-19, in the 28 GHz and other bands. Consideration of possible arrangements for HAPS will be progressed under a separate consultation process as demand and spectrum options become more certain.

# Consideration of technical issues

As arrangements for multiple services are being considered in the 28 GHz band, the potential for and issues associated with sharing and coexistence between these services need to be considered when determining and assessing possible options for the band.

1. **Are there any other technical issues the ACMA should consider regarding the ability for WWB, FWA, PTP and FSS to share or coexist in the 28 GHz band?**

## Sharing and coexistence between WWB/FWA and FSS

Sharing and coexistence between WWB/FWA and FSS has been extensively studied both domestically and internationally. There are three coexistence scenarios that needed to be considered in the context of the 28 GHz band:

* WWB/FWA and FSS gateways
* WWB/FWA and ubiquitous FSS (both fixed and ESIM)
* WWB/FWA and FSS satellite receivers.

Sharing studies conducted by Task Group 5/1 of the ITU-R suggest separation distances of less than 100m up to about 10 km (depending on the scenario) are required to enable WWB/FWA and FSS gateways to share the same frequency. Given the fixed and known location of FSS gateways along with the fact they only transmit in the 28 GHz band, it is considered that sharing would be possible with appropriate coordination procedures. In some cases, sharing could be improved by taking advantage of terrain, local clutter and other measures to improve site shielding.

In Australia, ubiquitous FSS are typically authorised for operation under a class licence. This means there is no requirement to register or coordinate individual terminals. For this reason, sharing with WWB/FWA (which also has ubiquitous fixed/mobile user terminals) in the same area is difficult to manage, even though the required separation distance to enable sharing can be quite small. Interference to and from ubiquitous FSS is usually managed by the planning arrangements put in place. This includes defining segments of the spectrum for use by ubiquitous FSS only.

Using this approach one option could be to allocate large population centres to WWB/FWA (were demand for these services is greatest) and regional/remote areas to ubiquitous FSS. The geographical separation of the services then helps to manage interference. In some instance, if suitable conditions are put in place, coexistence in the same geographical area using the same frequency may also be possible. For example, fixed ubiquitous FSS could take advantage of local shielding or deployed additional site shielding to reduce the risk of interference. Alternatively, limits could be placed on the transmit power and/or antenna elevation of terminals.

For ESIMs, enabling coexistence between WWB/FWA and mobile ubiquitous FSS is more complex. The mobile nature of terminals typically limits or removes the ability of operators taking advantage of site shielding. In this case, the most practical option for sharing is to segregate use of the band by frequency and/or geography. This is considered the only practical option for sharing between terrestrial ESIM and WWB/FWA.

For aeronautical and maritime ESIM, a more nuanced approach could be considered. Factors such as limiting ESIM use to defined heights above ground level and defined distance from the shore respectively could be implemented. Alternatively, geographical restrictions could be placed on the deployment of WWB around airports and maritime ports. Further consideration will need to be undertaken to determine whether such arrangements are viable and if so, what separation distances would be appropriate.

Where coexistence between WWB/FWA and ubiquitous FSS is being contemplated, there would be a need to define who is responsible for managing interference and any associated costs or risks involved. For example, should the onus be on FSS or WWB/FWA operators, and should this be different for different frequencies or geographic areas (i.e. Metro versus remote)? For instance, it could be that fixed ubiquitous FSS are supported in large population centres on the basis that FSS operators take practical measures to minimise interference to other existing or prospective service (such as appropriately locating terminals and using site shielding). Alternatively, in regional and remote areas, WWB/FWA could operate on the basis that they cannot claim protection from ubiquitous FSS. This type of use may work at mines or other locations where an operator controls access to a site.

The ability of WWB and FWA to share spectrum with FSS satellite receivers has been studied internationally by Task Group 5/1 of the ITU-R and domestically within an industry working group formed by the ACMA. As stated in the paper [*Future use of the 26 GHz band: Planning decisions and preliminary views*](https://www.acma.gov.au/theACMA/options-for-wireless-broadband-in-the-26-ghz-band), based on these studies, the ACMA is of the view that sharing is possible. However incumbent satellite operators were concerned that the (internationally agreed) parameters and assumptions that underpinned these studies might not be accurate estimates of actual WWB/FWA deployments. To safeguard against any potential divergence between assumed and actual operating conditions, the ACMA has proposed additional licence conditions for WWB or FWA use within satellite footprint areas in frequency segments that overlap with FSS. These additional conditions will be further refined within the technical liaison group that will be formed to develop spectrum licensing arrangements for access to the 26 GHz band. It is expected that any FSS satellite coexistence arrangements developed for the 26 GHz band will also be applicable to the 28 GHz band.

## Sharing and coexistence between PTP and FWA

Sharing between PTP and FWA has been extensively considered internationally (noting similar conclusions can be drawn for sharing between PTP and WWB). Deterministic sharing studies conducted by Task Group 5/1 of the ITU-R suggest separation distances ranging from 2.6–70 kilometres for the co-channel case and 0.9–12 kilometres for adjacent channel case (depending on the scenario) are required to enable PTP and FWA to share the same frequency. It is noted that the upper end of these separation distances is based on worst case assumptions, such as main beam-coupling, which can be easily mitigated via appropriate network design and base station placement. In practice the ACMA expects required separation distance to be much smaller.

The ACMA considers that coexistence between PTP and FWA is achievable through the development of appropriate coordination procedures. Similar arrangements have been successfully implemented between PTP and FWA (and WWB) in other bands, including the 1800 MHz and 2.1 GHz bands. The ability of these services to share is expected to improve in mmWave bands due to propagation characteristics at these frequencies.

## Sharing and coexistence between FSS and PTP

The ability for FSS gateways and PTP to share is well established. Arrangements supporting such use have been in place in numerous bands for decades now. In this case the highly direction nature of both FSS gateway and PTP antennas help improve the ability of the services to share and help minimise any spectrum denial caused to prospective future service deployments. The same can also be said for the ability of PTP to share with FSS satellite receivers.

Regarding PTP and ubiquitous FSS:

* sharing between is possible under segregated spectrum and/or geographical arrangements
* coexistence (i.e. same frequency and same geographic area) may be possible if appropriate conditions for use are put in place, as discussed in the ‘Sharing and coexistence between WWB/FWA’section. It is noted that further analysis and consultation with stakeholders will be required to determine appropriate arrangements to manage the risk of interference and develop and associated resolution issues.

# 28 GHz band options

The ACMA has identified a number of options for replanning the 28 GHz band. Each option is essentially a different combination of a handful of key independent variables, which can be grouped broadly by:

* the services or applications that will be allocated, this is limited to consideration of WWB, FWA, ubiquitous FSS, FSS gateways and PTP
* the geographic area(s) within which the band will be allocated

the frequency range(s) to be allocated.

This section provides a description of the planning options proposed for the 28 GHz band. Table 3 also provides a high-level summary of these options for comparison purposes.

When reading this section, it should be noted that:

* the term ‘large population centres’ is defined in Appendix A. These areas mirror those identified for spectrum licensing in the paper [*Future use of the 26 GHz band: Decisions and preliminary views*](https://www.acma.gov.au/theACMA/options-for-wireless-broadband-in-the-26-ghz-band)
* the frequency ranges and geographic boundaries of these options, while indicative of the ACMA’s thinking, may vary as a result of information provided in submissions to this paper
* the existing arrangements for body scanners defined in the [Radiocommunications (Low Interference Potential Devices) Class Licence 2015](https://www.legislation.gov.au/Details/F2018C00500) are considered to be appropriate and therefore are maintained under all options considered for the 28 GHz band
* the existing arrangements in the frequency range 28.5 GHz to 29.1 GHz for the FSS are considered to be appropriate and therefore are maintained under all options considered for the 28 GHz band
* this paper is limited to considering options and arrangements for the FSS uplink in the 27.5–29.5 GHz band. Options for the associated FSS downlink segment (17.7–20.2 GHz band) are not included. The ACMA expects to undertake further work on the associated downlink segment, when the scope of changes required for the uplink segment are clear
* while high altitude platform stations (HAPS) have been identified as a possible application in 28 GHz band, based on the interest and evidence supplied so far, the ACMA is not contemplating use of the band by HAPS at this time. Furthermore, WRC-19 agenda item 1.14 is still investigating additional identifications for HAPS in a variety of bands. The ACMA monitor international and domestic developments for HAPS, including the outcomes of WRC-19, in the 28 GHz and other bands. Consideration of possible arrangements for HAPS will be progressed under a separate consultation process as demand and spectrum options become more certain.

1. **Do stakeholders have comments on any of the options proposed in this section or other options to propose?**
2. **Is the definition of ‘large population centres’ (as described in Appendix A), suitable for application in Options 1a, 1b, 2 and 3?**

## Option 1: All services/applications provided spectrum allocations

Option 1 provides arrangements for access to all or part of the 28 GHz band for all services/uses identified as having an interest in the band. This includes WWB, FWA, FSS (both gateways and ubiquitous) and PTP. Different combinations of frequency and geographical segregation have been used to develop two sub-options for consideration. These are referred to as Option 1a and Option 1b and are described in detail below. Refer also to Figures 3 and 4 for an illustration of Option 1a and Option 1b respectively.

### Option 1a

1. Illustration of Option 1a[[23]](#footnote-24)



\* Ubiquitous FFS use would be on a ‘no interference’ basis and would likely include additional restrictions on service deployment to help manage interference.

27.5–28.1 GHz

* Re-allocate (or designate) the frequency range for the issue of spectrum licences in large population centres. This is expected to be of primary interest to operators wishing to deploy WWB services but can also be used to deploy other services such as FSS. The ACMA expects that given the sharing scenario is the same, the same technical framework implemented for the 26 GHz band would also be adopted for this band. This includes implementing the same measures to achieve coexistence with FSS satellite receivers.
* Maintain the existing site-based apparatus licensed arrangements for FSS gateways outside of those areas re-allocated (or designated) for the issue of spectrum licences.

Introduce arrangements to support ubiquitous FSS outside of those populated areas re-allocated (or designated) for the issue of spectrum licences.

28.1–28.5 GHz and 29.1–29.5 GHz

* Maintain the existing site-based apparatus licensed arrangements for PTP and FSS gateways Australia-wide.
* Introduce apparatus licensed arrangements for localised or site-based FWA services Australia-wide. The same arrangements as developed for FWA (Type 2 use) in the 26 GHz band would be adopted in this case.

Introduce arrangements to support limited deployments of ubiquitous FSS Australia-wide, on a ‘no interference’ basis with licensed PTP and FWA services. This could also include restrictions on deployments, similar to the variation proposed for Option 1b (refer to the discussion under Option 1b for details).

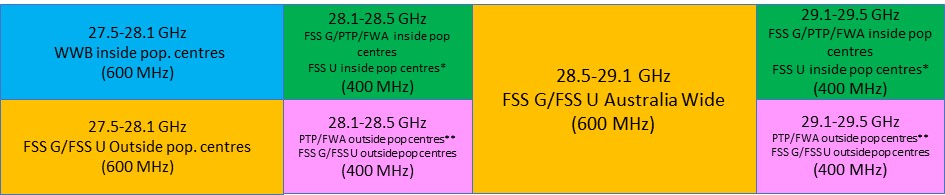
28.5–29.1 GHz

* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.

Maintain the existing arrangements for ubiquitous FSS Australia-wide.

**Option 1b**

1. Illustration of Option 1b[[24]](#footnote-25)



\* This is a possible variation where ubiquitous FFS use would be on a ‘no interference’ basis and could include additional restrictions on service deployment to help manage interference.

\*\* This is a possible variation that could be considered. If adopted PTP/FWA outside of large population centres would be on a ‘no protection’ basis with respect to ubiquitous FSS use.

The same arrangements as defined for Option 1a apply under Option 1b with the following changes to the 28.1–28.5 GHz and 29.1–29.5 GHz frequency ranges:

28.1–28.5 GHz and 29.1–29.5 GHz

* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.
* Maintain the existing site-based apparatus licensed arrangements for PTP in large population centres. Existing PTP licences outside these centres would be grandfathered for a minimum period of time (to be determined) during which they would be provided ongoing protection.
* Introduce apparatus licensed arrangements for localised or site-based FWA services in large population centres. The same arrangements as developed for FWA (Type 2 use) in the 26 GHz band would be adopted in this case.

Introduce arrangements to support ubiquitous FSS outside of large population centres.

A variation to Option 1b could be to permit ubiquitous FSS, PTP and FWA (in 28.1–28.5 GHz and 29.1–29.5 GHz) to operate Australia-wide but with varying primacy, as discussed in the ‘Consideration of technical issues’ section of this paper.

Under this approach, PTP and FWA would have primacy in large populations centres. Ubiquitous FSS would be permitted to operate in these on a ‘no interference basis’ and may also be subject to other deployment restrictions to minimise the risk of interference. This could include, for example, limiting terrestrial deployments to fixed ubiquitous FSS and meeting minimum levels of off-axis radiated power. For aeronautical and maritime ESIM use, further discussion would be required to determine whether operation within defined separation distances (including altitude) would be required or if restrictions on FWA deployments in and around airports and maritime ports should be imposed to manage interference.

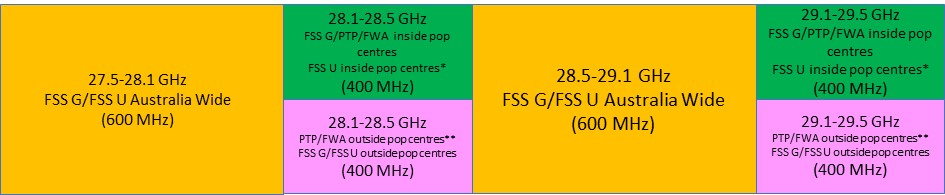
Outside of large populations centres ubiquitous FSS (both fixed and ESIM) would have priority and no restrictions on deployment. While PTP and FWA could operate, it would be on a ‘no protection’ basis.

If this variation is adopted, it is acknowledged that further work would be required to determine the exact nature of any conditions that might apply to PTP, FWA and ubiquitous FSS. This work would be conducted as part of the ACMA usual process of developing technical arrangements for access to a band and would include a public consultation process.

## Option 2: FSS with support for PTP/FWA

Option 2 provides arrangements for FSS (both gateways and ubiquitous) across the entire 28 GHz band as well as support for PTP and FWA in the 28.1–28.5 GHz and 29.1–29.5 GHz frequency ranges. Noting there are possible variations to this option, the baseline approach to Option 2 is illustrated in Figure 5 and described in more detail below.

1. Illustration of Option 2[[25]](#footnote-26)



\* This is a possible variation to Option 2 that could be considered. If adopted ubiquitous FSS use inside large population centres would be on a ‘no interference’ basis and could include additional restrictions on service deployments to manage interference.

\*\* This is a possible variation to Option 2 that could be considered. If adopted PTP/FWA outside of large population centres would be on a ‘no protection’ basis to ubiquitous FSS use.

27.5–28.1 GHz

* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.

Introduce arrangements to support ubiquitous FSS Australia-wide.

28.1–-28.5 GHz and 29.1–29.5 GHz

* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.
* Maintain the existing site-based apparatus licensed arrangements for PTP in large population centres. Existing PTP licences outside these areas would be grandfathered for a minimum period of time (to be determined) during which they would be provided ongoing protection.
* Introduce apparatus licensed arrangements for localised or site-based FWA services in large population centres. Similar arrangements as developed for FWA (Type 2 use) in the 26 GHz band could be adopted in this case.

Introduce arrangements to support ubiquitous FSS outside of large population centres.

28.5–29.1 GHz

* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.

Maintain the existing arrangements for ubiquitous FSS Australia-wide.

As per Option 1b, a possible variation to Option 2 could be to permit ubiquitous FSS, PTP and FWA (in 28.1–28.5 GHz and 29.1–29.5 GHz) to operate Australia-wide but with varying primacy. Refer to Option 1b for further discussion on this variation.

## Option 3: FSS with support for FWA

Option 3 provides arrangements for FSS (both gateways and ubiquitous) across the entire 28 GHz band as well as support for FWA in the 27.5–27.9/28.1 GHz frequency range. Under this option the current PTP arrangements in the band would be removed. Existing PTP licences would then be grandfathered for a minimum period of time (to be determined) during which they would be provided ongoing protection.

Adoption of this option is predicated on the existing 112 MHz PTP channel arrangements in the 28 GHz band being supported in another band. As discussed in the ‘Consideration of spectrum options for PTP’ section of this paper, the ACMA intends to consult on introducing 112 MHz channel arrangements into the 38 GHz band. A decision on changes to the 38 GHz band could be made early Q3 2019 and would feed into any decisions made for the 28 GHz band, including the viability of adopting Option 3.

Option 3 is illustrated in Figure 6 and described in more detail below.

1. Illustration of Option 3[[26]](#footnote-27)

Illustration of Option 3

\* This is a possible variation to Option 3 that could be considered. If adopted ubiquitous FSS use inside large population centres would be on a ‘no interference’ basis and could include additional restrictions on service deployments to manage interference.

\*\* This is a possible variation to Option 2 that could be considered. If adopted PTP/FWA outside of large population centres would be on a ‘no protection’ basis to ubiquitous FSS use.

27.5–27.9/28.1 GHz

* Introduce apparatus licensed arrangements for localised or site-based FWA services in large population centres. Similar arrangements as developed for FWA (Type 2 use) in the 26 GHz band could be adopted in this case.
* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.

Introduce arrangements to support ubiquitous FSS outside of large population centres.

27.9/28.1–28.5 GHz and 29.1–29.5 GHz

* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.
* Retire the existing site-based apparatus licensed arrangements for PTP Australia-wide. Existing PTP licences would be grandfathered for a minimum period of time (to be determined) during which they would be provided ongoing protection.

Introduce arrangements to support ubiquitous FSS Australia-wide.

28.5–29.1 GHz

* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.

Maintain the existing arrangements for ubiquitous FSS Australia-wide.

As per Option 1b, a possible variation to Option 3 could be to permit ubiquitous FSS and FWA (in 27.5–27.9/28.1 GHz) to operate Australia-wide but with varying primacy. Refer to Option 1b for further discussion on this variation.

## Option 4: FSS only

Option 4 provides arrangements for FSS (both gateways and ubiquitous) across the entire 28 GHz band Australia-wide. Under this option the current PTP arrangements in the band would be removed. Existing PTP licences would then be grandfathered for a minimum period of time (to be determined) during which they would be provided ongoing protection.

Adoption of this option is predicated on the existing 112 MHz PTP channel arrangements in the 28 GHz band being supported in another band. As discussed in the ‘Consideration of spectrum options for PTP’ section of this paper, the ACMA intends to consult on introducing 112 MHz channel arrangements into the 38 GHz band. A decision on changes to the 38 GHz band could be made early Q3 2019 and would inform any decisions made for the 28 GHz band.

Option 4 is illustrated in Figure 7 and described in more detail below.

1. Illustration of Option 4

Illustration of Option 4

27.5–28.1 GHz

* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.

Introduce arrangements to support ubiquitous FSS Australia-wide.

28.1–28.5 GHz and 29.1–29.5 GHz

* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.
* Retire the existing site-based apparatus licensed arrangements for PTP Australia-wide. Existing PTP licences would be grandfathered and provided ongoing protection.

Introduce arrangements to support ubiquitous FSS Australia-wide.

28.5–29.1 GHz

* Maintain the existing site-based apparatus licensed arrangements for FSS gateways Australia-wide.

Maintain the existing arrangements for ubiquitous FSS Australia-wide.

## Summary of options

1. Summary of options

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Option** | **FSS (Gateway)** | **FSS (ubiquitous)** | **WWB** | **FWA** | **PTP** |
| Option 1a | 27.5–28.1 GHz  Allocation outside spectrum licensed areas  28.1–29.5 GHz  Allocation Australia-wide | 27.5– 28.1 GHz  Allocation outside spectrum licensed areas  28.1–28.5 GHz & 29.1–29.5 GHz  Allocation Australia-wide (restrictions apply)  28.5–29.1 GHz  Allocation Australia-wide | 27.5– 28.1 GHz  Possible use inside areas re-allocated/ designated for spectrum licensing | 28.1–28.5 GHz & 29.1–29.5 GHz  Allocation Australia-wide | 28.1–28.5 GHz & 29.1–29.5 GHz  Allocation Australia-wide |
| Option 1b | 27.5–28.1 GHz  Allocation outside spectrum licensed areas  28.1–29.5 GHz  Allocation Australia-wide | 27.5– 28.1 GHz  Allocation outside spectrum licensed areas  28.1–28.5 GHz & 29.1–29.5 GHz  Allocation inside large pop. centres (restrictions apply)\*\*  Allocation outside large pop. centres (no restrictions apply)  28.5–29.1 GHz  Allocation Australia-wide | 27.5– 28.1 GHz  Possible use inside areas re-allocated/ designated for spectrum licensing | 28.1–28.5 GHz & 29.1–29.5 GHz  Allocation inside large population centres  Allocation outside large population centres on a no protection basis from ubiquitous FSS\*\* | 28.1–28.5 GHz & 29.1–29.5 GHz  Allocation inside large population centres  Grandfather existing licences outside large population centres  Allocation outside large population centres for new licences on a no protection basis from ubiquitous FSS\*\* |
| Option 2 | 27.5–29.5 GHz  Allocation Australia-wide | 27.5– 28.1 GHz & 28.5–29.1 GHz  Allocation Australia-wide  28.1–28.5 GHz & 29.1–29.5 GHz  Allocation inside large pop. centres (restrictions apply)\*\*  Allocation outside large pop. centres (no restrictions apply) | No allocation | 28.1–28.5 GHz & 29.1–29.5 GHz  Allocation inside large population centres  Allocation outside large population centres on a no protection basis from ubiquitous FSS\*\* | 28.1–28.5 GHz & 29.1–29.5 GHz  Allocation inside large population centres  Grandfather existing licences outside large population centres  Allocation outside large population centres for new licences on a no protection basis from ubiquitous FSS\*\* |
| Option 3 | 27.5–29.5 GHz  Allocation Australia-wide | 27.5–29.5 GHz  Allocation Australia-wide | No allocation | 27.5– 27.9/28.1 GHz  Allocation inside large population centres  Allocation outside large population centres on a no protection basis from ubiquitous FSS\*\* | No allocation, existing licences grandfathered |
| Option 4 | 27.5–29.5 GHz  Allocation Australia-wide | 27.5–29.5 GHz  Allocation Australia-wide | No allocation | No allocation | No allocation, existing licences grandfathered |

\*\* This is a possible variant to the option that could be considered

# Assessment of options

An assessment of each of the identified options against the [Principles for Spectrum Management](http://www.acma.gov.au/theACMA/About/The-ACMA-story/Facilitating/decisionmaking-process-fyso-25-1) (as described in the ‘Legislative and policy environment’chapter), is contained below. This analysis is informed by both ACMA analysis and responses to the September 2018 paper. The Principles are:

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

Table 4 summarise the assessment of the different options against each of the Principles. The subsequent discussion explores the assessment of each option against the Principles in more detail.

1. **Do stakeholders have any comments on the discussion and outcomes of the assessment of each option against the Principles?**
2. Summary of assessment of options against Spectrum Management Principles

|  | Option 1a—All services | Option 1b—All services | Option 2—FSS/PTP/FWA | Option 3—FSS/FWA | Option 4—FSS |
| --- | --- | --- | --- | --- | --- |
| **Principle 1** | * Provides arrangements for WWB, FWA, PTP and FSS * A considerable amount of spectrum has been identified for WWB use in the 26 GHz band, questionable if providing more represents HVU of 28 GHz | * Provides arrangements for WWB, FWA, PTP and FSS * A considerable amount of spectrum has been identified for WWB use in the 26 GHz band, questionable if providing more represents HVU of 28 GHz | * Provides arrangements for FWA, PTP and FSS * Satisfies Principle if arrangements for 28 GHz PTP cannot be supported in other bands | * Provides arrangements for FWA, and FSS * Satisfies Principle if arrangements for 28 GHz PTP can be supported in other bands | * Provides arrangements for FSS * Partially satisfies Principle as no arrangements for FWA or PTP are provided |
| **Principle 2** | * May not satisfy Principle in areas subject to spectrum licensing as this is not optimal for use by multiple different licensees and services * Satisfies Principle outside of areas subject to spectrum licensing as it enables FWA, PTP and FSS use | * May not satisfy Principle in areas subject to spectrum licensing as this is not optimal for use by multiple different licensees and services * Satisfies Principle outside of areas subject to spectrum licensing as it enables FWA, PTP and FSS use | * Enables FWA, PTP and FSS use * Satisfies Principle if arrangements for 28 GHz PTP cannot be supported in other bands | * Enables FWA and FSS use * Satisfies Principle if arrangements for 28 GHz PTP can be supported in other bands | * Partially satisfies Principle as it enables FSS use of the entire band. However, it does not enable FWA use and results in removal of PTP arrangements |
| **Principle 3** | * Higher costs for areas subject to spectrum licensing * Spectrum licensing provides least restrictive use of spectrum for single licensees providing services over large areas. However, use of spectrum by multiple different licensees and services is better supported by apparatus and class licence regimes. * In line with Government policy objectives of promoting sharing and fostering a competitive telecommunications market | * Higher costs for areas subject to spectrum licensing * Spectrum licensing provides least restrictive use of spectrum for single licensees providing services over large areas. However, use of spectrum by multiple different licensees and services is better supported by apparatus and class licence regimes. * In line with Government policy objectives of promoting sharing and fostering a competitive telecommunications market | * Less cost approach than Option 1. Similar cost to Options 3 and 4 as implementation is via apparatus and class licensing regimes * Use of spectrum by multiple different licensees and services is better supported by apparatus and class licence regimes. * In line with Government policy objectives of promoting sharing and fostering a competitive telecommunications market * Least restrictive option if 28 GHz PTP cannot be supported in other bands | * Less cost approach than Option 1. Similar cost to Options 2 and 4 as implementation is via apparatus and class licensing regimes * Incumbent PTP grandfathered * Use of spectrum by multiple different licensees and services is better supported by apparatus and class licence regimes. * In line with Government policy objectives of promoting sharing and fostering a competitive telecommunications market * Least restrictive option if 28 GHz PTP can be supported in other bands | * Less cost approach than Option 1. Similar cost to Options 2 and 3 as implementation is via apparatus and class licensing regimes * Incumbent PTP grandfathered * More restrictive than Options 1a, 1b, 2 and 3 as only provides arrangements for FSS. This is not in line with the Government policy objective of promote sharing |

|  | Option 1a—All services | Option 1b—All services | Option 2—FSS/PTP/FWA | Option 3—FSS/FWA | Option 4—FSS |
| --- | --- | --- | --- | --- | --- |
| **Principle 4** | * Spectrum licensing provides greatest certainty due to licence tenure and rights afforded * In areas not subject to spectrum licensing, apparatus licensing provides certainty via the technical arrangements put in place for use of the band. This provides use of spectrum in an interference managed environment * For ubiquitous FSS, certainty is provided by limiting use to those areas and portions of the band only allocated to the FSS. Further flexibility via shared use may be supported, if deployment restrictions are placed on ubiquitous FSS * Spectrum licences are inherently flexible in how they can be used. They are typically not used to support multiple services and operators * In areas not subject to spectrum licensing, flexibility is provided by implementing shared arrangements for FWA, PTP and FSS, as appropriate. | * Spectrum licensing provides greatest certainty due to licence tenure and rights afforded * In areas not subject to spectrum licensing, apparatus licensing provides certainty via the technical arrangements put in place for use of the band. This provides use of spectrum in an interference managed environment * For ubiquitous FSS, certainty is provided by limiting use to those areas and portions of the band only allocated to the FSS. Further flexibility via shared use may be supported, if deployment restrictions are placed on ubiquitous FSS * Spectrum licences are inherently flexible in how they can be used. They are typically not used to support multiple services and operators * In areas not subject to spectrum licensing, flexibility is provided by implementing shared arrangements for FWA, PTP and FSS, as appropriate | * Apparatus licensing provides certainty via the technical arrangements put in place for use of the band. This provides use of spectrum in an interference managed environment * For ubiquitous FSS, certainty is provided by limiting use to those areas and portions of the band only allocated to the FSS. Further flexibility via shared use may be supported, if deployment restrictions are placed on ubiquitous FSS * Flexibility is provided by implementing shared arrangements for FWA, PTP and FSS, as appropriate | * Apparatus licensing provides certainty via the technical arrangements put in place for use of the band. This provides use of spectrum in an interference managed environment * For ubiquitous FSS, certainty is provided by limiting use to those areas and portions of the band only allocated to the FSS. Further flexibility via shared use may be supported, if deployment restrictions are placed on ubiquitous FSS * Flexibility is provided by implementing shared arrangements for FWA and FSS, as appropriate | * This option maximises certainty for the FSS * Apparatus licensing provides certainty via the technical arrangements put in place for use of the band. This provides use of spectrum in an interference managed environment * Certainty provided for ubiquitous FSS use of the entire 28 GHz band Australia-wide as there are only arrangements in place to support FSS * This option maximises flexibility for the FSS as it does not need to contend for spectrum with any other service * This option does not provide flexibility for use of the band by services other than the FSS |

|  | Option 1a—All services | Option 1b—All services | Option 2—FSS/PTP/FWA | Option 3—FSS/FWA | Option 4—FSS |
| --- | --- | --- | --- | --- | --- |
| **Principle 5** | * The mix of spectrum and apparatus licensing arrangements result in best balance between increased spectrum utilisation and interference management for WWB, FSS gateways, FWA and PTP * Spectrum licence arrangements for WWB come at the expense of reduced access to spectrum in large population centres for the FSS * Further spectrum utilisation by ubiquitous FSS is supported in bands used by FWA and PTP if deployment restrictions are placed on ubiquitous FSS | * The mix of spectrum and apparatus licensing arrangements result in best balance between increased spectrum utilisation and interference management for WWB, FSS gateways, FWA and PTP * Spectrum licence arrangements for WWB come at the expense of reduced access to spectrum in large population centres for the FSS * Further spectrum utilisation by ubiquitous FSS may be supported in bands used by FWA and PTP if deployment restrictions are placed on ubiquitous FSS. Similarly, greater use of areas and frequencies allocated to FSS only could be supported if FWA and PTP operate on a ‘no protection’ basis’ | * The apparatus licensing arrangements result in a good balance between increased spectrum utilisation and interference management for FSS gateways, FWA and PTP * Further spectrum utilisation by ubiquitous FSS may be supported in bands used by FWA and PTP if deployment restrictions are placed on ubiquitous FSS. Similarly, greater use of areas and frequencies allocated to FSS only could be supported if FWA and PTP operate on a ‘no protection’ basis’ | * The apparatus licensing arrangements result in good balance between increased spectrum utilisation and interference management for FSS gateways, FWA and PTP * Further spectrum utilisation by ubiquitous FSS may be supported in bands used by FWA if deployment restrictions are placed on ubiquitous FSS. Similarly, greater use of areas and frequencies allocated to FSS only could be supported if FWA operate on a ‘no protection’ basis’ | * Only provides support for FSS, consequently results in worst balance between spectrum utilisation and interference management |

### Principle 1—Allocate spectrum to the highest value use (HVU) or uses

In determining the highest value use or uses of the 28 GHz band, the ACMA considers the use or combination of uses that maximise the total economic value derived from using the spectrum. This is typically measured using the Total Welfare Standard (TWS), under which the impact that a regulatory proposal has on the public interest is measured as the sum of the effects on consumers, producers and government, as well as the broader social impacts on the community.

The following analysis assesses the replanning options put forward in this paper and focuses on the potential for each use case to increase economic value under the TWS. It is noted that the ACMA’s contentions about the highest value use of the 28 GHz band are largely based on the outcomes of other planning initiatives and in some cases anecdotal evidence, particularly:

* the marginal incremental value of further WWB is considered to be minimal, given the identification of spectrum in the 26 GHz band and the range of other mmWave bands being considered for use by WWB services
* the potential utility of spectrum being made available for FWA across the 26 GHz and 28 GHz bands
* increasing demand for access to large bandwidth channels by PTP services and whether arrangements in other bands would be suitable to accommodate this
* the potential utility of spectrum being made available for FSS

the potential high incremental costs of displacing existing services from the 28 GHz band.

WWB

The social and economic benefits of WWB have been clearly articulated in numerous papers, including those produced by the Australian Mobile Telecommunications Association (AMTA)[[27]](#footnote-28),[[28]](#footnote-29) and the Department of Communications and Arts[[29]](#footnote-30). To realise these benefits and to continue to deliver new and evolving services, access to sufficient spectrum is required by WWB operators. Therefore, in part, determining whether WWB should be allocated spectrum in the 28 GHz band hinges on whether the net increment value of WWB in this spectrum is likely to be greater than other services.

As detailed in the *Outcomes of the 26 GHz band replanning process* section of this paper, the ACMA has flagged a planning decision that 2.4 GHz of spectrum should be identified for spectrum licensing in the 26 GHz band within large population centres. This is expected to be of primary interest to WWB operators and the spectrum is considered substitutable to the 28 GHz band. As a result of this allocation, the ACMA contends that a significant amount of spectrum has already been made available for WWB use in the 24.25-29.5 GHz frequency range – particularly when access to more spectrum for WBB is weighed against a combination of alternative uses (on a shared basis) such as FWA, FSS gateways and (possibly) ubiquitous FSS. It is further noted that numerous other mmWave bands are under active consideration for WWB use which will help to meet future growth and capacity demands. Refer to the ‘Consideration of spectrum options for WWB’section of this paper for further discussion.

If the ACMA’s contention is correct that a suitable amount of spectrum for WWB use has already been identified in the 26 GHz band, neither sub-option 1a or 1b are expected to maximise economic value under the TWS and therefore these options are not considered to be the highest value uses of the band.

1. **Is there any relevant evidence that provides an indication of the value the WWB sector places on additional spectrum in the 28GHz band?**

FWA

Any allocation for FWA use in the 28 GHz band needs to consider the spectrum requirements of WISPs, local governments, miners, utility companies and other localised or site-based wireless broadband operators. In submissions to the September 2018 paper, it was suggested that a minimum allocation in the order of 800-1000 MHz would be necessary to support multiple FWA operators and allow each to provide a competitive service in the 26 GHz and/or 28 GHz bands. Due to the substitutability of spectrum in the 26 GHz and 28 GHz bands, such an allocation could be made in either band. Provided that the allocation of spectrum to FWA is not at the expense of a higher value use case, the ACMA contends the quantum of spectrum between 800–1000 MHz is a reasonable estimate across the 26 GHz and 28 GHz bands, particularly in large population centres where demand for FWA spectrum is expected to be highest. Given arrangements could be put in place to support sharing between FWA and other services such as PTP, FSS gateways and (possibly) ubiquitous FSS, the combined use case provides a good argument for being the HVU.

As detailed in the ‘Outcomes of the 26 GHz band replanning process’section of this paper, the ACMA has flagged a planning decision for FWA use which includes 400 MHz in large population centres and 2.8 GHz in regional and remote areas (noting that at least 2.4 GHz of the latter will be of interest to WWB licensees in specific areas).

To reach a potential allocation of 800–1000 MHz of spectrum for FWA in all areas across the 26 GHz and 28 GHz bands, an additional 400–600 MHz is required in the 28 GHz band in large population centres. Option 2 and Option 3 each provide an allocation of 400-600 MHz[[30]](#footnote-31) of spectrum for FWA and are the most likely optionsto maximise economic value under the TWS and ultimately represent the highest value use combination for the 28 GHz band. This is particularly the case when the shared nature of any FWA allocation is considered. For instance, under Option 2, FWA would share its allocation with FSS gateways and PTP, and under Option 3 it would share with FSS gateways. As a possible variant to both options, sharing with ubiquitous FSS could also be considered.

Additional allocations for FWA in regional and remote areas are also considered as a variation to Option 2 and Option 3. However, due to the proposed 2.8 GHz allocation in the 26 GHz band, such use is proposed on a ‘no protection’ basis to ubiquitous FSS use. The intention of the variation is to provide options for greater access to and utility of spectrum but not at the expense of further limiting ubiquitous FSS use. It is anticipated that this option could be implemented at mine sites or other locations where access to a site is controlled (or in situations where the risk of interference is manageable). Where viable, the ACMA contends such use maximises net incremental economic value under the TWS and ultimately represents the highest value use of the spectrum.

1. **Is there any relevant evidence that provides an indication of the value the FWA sector places on additional spectrum in this band?**

PTP

In addition to the 28 GHz band, there are several other bands in the 18-40 GHz frequency range that provide arrangements for PTP services. Due to demand for access to the 28 GHz band from other services, the ACMA has investigated whether PTP arrangements in other bands are adequate to meet the growing needs of the PTP industry. This will help the ACMA determine whether ceasing support for the PTP arrangements in the 28 GHz band would maximise access to the band by other services and ultimately maximise the economic value derived from use of the band.

The PTP arrangements in 28 GHz band provide 28 MHz, 56 MHz and 112 MHz channel options. There are equivalent arrangements in place in other bands to support demand for 28 MHz and 56 MHz channel sizes, but there are no equivalent arrangements in other bands for 112 MHz channels. Providing industry with access to 112 MHz channels is considered necessary to meet its growing capacity requirements, which is evident in the shift from smaller to larger bandwidth channels by PTP operators in Australia seen over time[[31]](#footnote-32). This demand is expected to grow in the advent of 5G and the associated increase in data backhaul requirements.

The ACMA intends to consult on the inclusion of 112 MHz channel arrangements for PTP into the 38 GHz band in Q2 2019. While this will be done in a separate discussion paper, it is expected a decision on the viability of these arrangements can be made by early Q3 2019. The ACMA will take into account views submitted to this paper as well as the outcomes of the 38 GHz consultation process when making any decisions on the future of PTP in the 28 GHz band. It is noted that the 38 GHz band is part of a broader frequency range (37-43.5 GHz) being considered globally for 5G services. The ACMA notes that changes to the 38 GHz band and increase in its utility for PTP purposes will be a factor in any future considerations determining what, if any, part of the broader band is suitable for 5G.

If the proposed new arrangements in the 38 GHz band are deemed appropriate to meet demand for large bandwidth PTP services, then the net economic value derived from continued PTP use of the 28 GHz band could be substantially diminished and the cessation of 28 GHz PTP arrangements could be considered. In the event it is decided to no longer support 28 GHz PTP arrangements, Option 3 or Option 4 are likely to represent the highest value use cases for the 28 GHz band. This is because a minimal value would be derived from additional PTP services using the band when a viable alternative band exists (noting that existing PTP services would be grandfathered under each option). However, if the new arrangements in the 38 GHz band are not considered sufficient to meet demand or are not implemented, the ACMA considers options that maintain the existing PTP arrangements in the 28 GHz band–—Option 1 and Option 2—could be more likely to represent the highest value use(s) of the band.

1. **What value do PTP operators place on having access to 112 MHz channels? If similar arrangements could be implemented in the 38 GHz band, would they be a suitable replacement for the 28 GHz band?**
2. **Is there any evidence that provides an indication of the value the PTP sector places on maintaining access to this band?**

FSS

There is increasing demand for access to more spectrum for the FSS. Much of this growth is due to an increase of ubiquitous FSS deployments and the need for higher capacity gateways to support such use. Access to spectrum in the Ka band (which includes the 17.7-20.2 GHz frequency range for downlinks and 27–30 GHz frequency range for uplinks) is important for these satellite systems due to the large amount of spectrum available and the increasing level of congestion in lower frequency bands.

Many of the existing FSS gateways in the 28 GHz band are used to support broadband satellite services such as NBN Co’s SkyMuster. The ACMA considers it is important to ensure that existing FSS gateways (as well as ubiquitous FSS) can continue operating in the 28 GHz band—the incremental costs involved in displacing existing FSS gateways are likely to far outweigh the potential incremental benefits of an alternative use. The ACMA also recognises the interests of other satellite operators in deploying FSS gateways in Australia to support the delivery of their services both domestically and internationally.

When it comes to FSS gateways, sharing with PTP and FWA services on a coordinated basis is considered possible–this has already been proven to work in numerous other bands. Option 2 and Option 3 are therefore most likely to represent a highest value use combination for the 28 GHz band rather than Options 1a, 1b and 4. This is because they each provide arrangements for the FSS and include sharing with PTP (for Option 2) and FWA, increasing the probability that economic value would be maximised under the TWS. While Options 1a and 1b also provide similar arrangements, the segments identified for possible spectrum licensing could restrict such use unless spectrum licensees were prepared to third party authorise them.

It is acknowledged that satellite operators would generally prefer not to be geographically restricted in their use to maximise business opportunities and reduce complexity in their network, particularly when it comes to ubiquitous FSS use. Both fixed ubiquitous FSS and ESIM could be used to provide services in large population centres, at major maritime ports/airports, along domestic and international flight paths and at sea. Therefore, any option that excludes ubiquitous FSS from large population centres may limit the potential benefits realised from such use and may not be welfare maximising. Of course, this needs to be balanced against the needs of other services wanting to access the same spectrum, where appropriate.

For the options presented in this paper, in those segments of the 28 GHz band that are only proposed for use by FSS gateways, it is noted that including support for ubiquitous FSS would not change the interference environment between different satellite operators. However, it would facilitate increased use of the spectrum. The ACMA considers this to result in the HVU of the spectrum. Therefore, all options presented in this paper enable such use.

For those segments of the 28 GHz that are shared between the FSS and other services, a different approach is required in order to manage interference. In such cases, the ACMA considers that sharing may be possible under specific conditions. For example, in large population centres where PTP and FWA could be considered the highest value use, ubiquitous FSS could be permitted to operate on a ‘no interference basis’. To minimise the risk of interference terminals could also be subject to other deployment restrictions. Outside of large populations centres, ubiquitous FSS (both fixed and ESIM) could have priority and therefore no restrictions on deployment, while PTP and FWA could operate on a ‘no protection’ basis.

It is acknowledged that further work is required to determine the exact nature of any restrictions that could apply to support sharing between ubiquitous FSS and other services. However, given the demand for access to spectrum in the 28 GHz band from a variety of potentially valuable use cases, the ACMA considers an approach that allows multiple services to operate on the same frequency and in the same (or reasonably close) area is likely to be welfare maximising and result in the highest value use combination for the band. Options 1b, 2 and 3 in this paper have possible variants that propose such sharing arrangements.

1. **Is there any evidence that provides an indication of the value the FSS sector places on access to this band?**

Summary

Based on the preceding discussion, the highest value use of the band is more likely to include some combination of FSS gateways, ubiquitous FSS, FWA and PTP. The option that best satisfies each of these use cases and is likely to represent the highest value use of the 28 GHz band is therefore Option 2. However, it is noted that the ACMA is still investigating whether the existing PTP arrangements in the 28 GHz band can be supported in other bands. This will be assessed following the outcomes of a parallel discussion process investigating the introduction of 112 MHz channel arrangements in the 38 GHz band. Pending the outcome of this separate discussion process and consideration of submissions received to this paper, there is the possibility PTP arrangements in the 28 GHz band could be retired. In the event this occurs, the allocation option that would represent the highest value uses of the 28 GHz band is Option 3.

### Principle 2—Enable and encourage spectrum to move to its HVU

Based on the analysis in Principle 1, the HVU for the 28 GHz band is achieved when arrangements are implemented that support use by FWA, PTP (pending further investigation on whether arrangements can be adequately supported in other bands), ubiquitous FSS and FSS gateways.

FWA, PTP and FSS gateway use of spectrum can be characterised as being site-based (or localised in area) services deployed by multiple different operators. Spectrum licensing arrangements are not considered optimal in this case unless the licensee is prepared to act as a neutral band manager (similar to the ACMA) and provide fair and equitable access to the band for multiple service types and operators.

Class licensing arrangements are also not considered optimal for FWA, PTP and FSS gateway as they do not provide operators with the certainty required to deliver carrier grade services. In this case apparatus licensing arrangements are considered optimal to support use of spectrum by multiple services and multiple operators on a coordinated basis. Similar arrangements supporting multiple services and operators have been implemented in various other bands. The ability of these services to share is also expected to improve in mmWave bands due to propagation characteristics at these frequencies. It is also possible for apparatus licences arrangements similar to those proposed for FWA (or Type 2 use) in the 26 GHz band to be considered in the 28 GHz band. This could facilitate the deployment of multiple FWA base stations by a single operator in a localised area.

Ubiquitous FSS use of spectrum can be characterised as being the deployment of fixed and/or mobile user terminals. It is possible for multiple ubiquitous FSS operators (and FSS gateway operators) to coexist in the same areas using the same frequency. Extension of the existing arrangements that support ubiquitous FSS use in the 28.5–29.1 GHz band may be the most appropriate solution. This approach requires satellite operators to obtain an appropriate apparatus licence for the operation of their satellite within Australia. Obtaining such a licence then allows the operation of ubiquitous FSS terminals within the bands defined in the [Communications with Space Objects Class Licence](https://www.legislation.gov.au/Series/F2015L01486) without the need to register the location of devices.

Options 1a and 1b enables large portions of the 28 GHz band to be used for PTP, FWA and FSS gateway services under apparatus licenced arrangements. However, it may not encourage spectrum to move to its HVU in areas identified for spectrum licensing. This is because the issue of spectrum licences is likely to be of most interest to WWB operators. Consequently, it is unlikely Option 1a and 1b arrangements would adequately cater for FSS gateways and ubiquitous FSS unless the spectrum licensees act as a neutral band manager. Arrangements under these options also minimise the areas in which ubiquitous FSS can be deployed without restrictions in large population centres (both Option 1a and 1b) and regional/remote areas (Option 1a only).

Option 4 only supports use of FSS services. It therefore does not satisfy Principle 2 as there are no arrangements to support use of the band by FWA or PTP.

Option 2 enables and encourages spectrum to move to its HVU. It provides apparatus licence arrangements across the band Australia-wide for FSS gateways and spectrum for PTP and FWA in large population centres. This option also provides greater access to the 28 GHz band for ubiquitous FSS, noting that for 800 MHz of the band in large population centres this would be on a restricted basis (if this variation to the option is adopted). It is noted that while the retention of PTP arrangements would continue to provide support for large bandwidth channels, this could result in a reduction in the amount of spectrum available for other services deployed in the same or nearby area. While this is a real risk, ensuring there are several channels available to support multiple operators in an area, coupled with the directional nature of PTP antennas, is expected to minimise the impact.

Option 3 also enables and encourages spectrum to move to its HVU. It provides apparatus licence arrangements across the band Australia-wide for FSS gateways and spectrum for FWA in large population centres. This option also provides greater access to the 28 GHz band for ubiquitous FSS, noting that for 400/600 MHz of the band in large population centres this would be on a restricted basis (if this variation to the option is adopted). As a result, the ACMA intends to consult on whether large bandwidth channels can be supported in the 38 GHz band with an outcome due by early Q3 2019. Of course, adoption of this option is dependent on arrangements for PTP be adequately addressed in other bands.

### Principle 3—Use the least cost and least restrictive approach to achieving policy objectives

Least cost

The cost differentials between options that need to be considered are not financial costs but rather regulatory costs to affected operators. This mostly applies to incumbent users, as regulatory costs for prospective users are better described under the *least restrictive* aspect of the Principle.

Under all replanning options proposed, continued operation of incumbent licensed PTP and FSS services is supported. While PTP support may only be a for a defined period, the time chosen is intended to provide operators with sufficient time to recoup costs and realise benefits from their investment. This means any change in arrangements and possible increase in sharing with new services would incur no to low additional cost provided new regulations facilitating such deployments will not place new constraints on incumbent services. It follows that, under all replanning options considered in this paper, the costs to incumbents are likely to be low and there are no clear preferred (or ‘not preferred’) options for meeting this criterion.

Least restrictive

Spectrum licences offer the greatest freedom for licensees to optimise their use of the spectrum. Provided licensees adhere to the technical framework, they are free to use their spectrum as they see fit. As a general rule of thumb, the larger the area and frequency range occupied by a spectrum licence, the greater the freedom a licensee has. Such arrangements are considered ideal for WWB use and are proposed under Option 1a and 1b in a portion of the 28 GHz band in large population centres.

As discussed under Principle 2, spectrum licensing arrangements may not optimal to support the highest value uses of the 28 GHz band unless licensees are prepared to act as neutral band managers (similar to the ACMA) and provide fair and equitable access to the spectrum for multiple service types and operators. For the 28 GHz band apparatus licensing arrangements are considered optimal to support use of the spectrum by multiple site-based/localised services (FSS gateways, FWA and PTP) and multiple operators on a coordinated basis. Also, in the case of ubiquitous FSS the current licensing regime is consider practical. This allows user terminals to operate under a class licence, without the need to register their location, provided there is a valid apparatus licence for the satellite end.

Planning outcomes that result in shared use of spectrum by multiple different operators and services are also in in line with the Government policy objectives of promoting sharing and fostering a competitive telecommunications market.

On balance it would seem that quarantining parts of the 28 GHz band for the issue of spectrum licenses would most likely result in restrictions on the deployment of FWA, PTP and FSS. By that logic, Options 2 and 3 would be *less* restrictive than Options 1a and 1b. Options 2 and 3 are also in in line with the Government policy objectives of promoting sharing and fostering a competitive telecommunications market as they support shared use of spectrum by multiple different operators and services. Option 4 could be considered the most restrictive of all the options as it only provides arrangements for the FSS.

Determining which of Options 2 and 3 are least restrictive ultimately depends on whether PTP is considered to be one of the highest value uses of the band. If it is then Option 2 is least restrictive. If it is not, then Option 3 is least restrictive.

### Principle 4—To the extent possible, promote both certainty and flexibility

Certainty

Spectrum-licensing regimes provide more investment certainty than apparatus licensing, owing to both the tenure and rights afforded. Options 1a and 1b both consider implementing spectrum licence arrangements in the 28 GHz band. This is considered the best approach to support WWB use.

For FSS gateways, FWA and PTP services, apparatus licence arrangements are proposed. In this case certainty is provided via the technical arrangements put in place for access to the band, especially where access is on a shared basis. This enables multiple services and operators to access a band and for licensees to operate within a known interference environment. All options presented in this paper provide apparatus licence arrangements for FSS gateways, FWA and PTP services.

For ubiquitous FSS use, certainty is harder to provide as the location of user terminals is typically unknown and possibly mobile or nomadic in nature. In this instance certainty is usually provided via the planning arrangements implemented. For example, defining segments of the 28 GHz band and specific geographical areas for FSS only use provides ubiquitous FSS with access to spectrum in a controlled interference environment. This is because interference between different satellite systems is managed at the international level through processes defined by the ITU. Once a satellite system makes it through the relevant process, different FSS systems can typically operate on the same frequency in the same area. For this reason, Option 4 maximises certainty provided to the FSS as it is the only service operating in the 28 GHz band Australia-wide. All other options allocate different amounts of spectrum in different areas for exclusive FSS use. In some cases, sharing between ubiquitous FSS and other services is also considered. However, this flexibility comes at the expense of imposing constraints on the deployment of either ubiquitous FSS or other services.

Flexibility

As discussed under Principle 3, spectrum licences offer the greatest flexibility for use of the spectrum. This is because licensees are free to use their spectrum as they see fit, provided they adhere to the technical framework in place. Such arrangements are considered ideal for a single operator to invest in and deploy WWB services and are proposed under Option 1a and 1b.

As discussed under Principle 2, if WWB is not considered the highest value use of the band then spectrum licence arrangements may not be appropriate. This is because they are unlikely to provide support for multiple services and operators unless spectrum licensees are prepared to act as neutral band managers (similar to the ACMA) and provide fair and equitable access to the spectrum for multiple service types and operators. In this case apparatus licensing arrangements provide the flexibility to support use of the spectrum by multiple site-based/localised services (FSS gateways, FWA and PTP) and multiple operators as needed on a coordinated basis.

Furthermore, additional flexibility can also be provided in segments of the 28 GHz band that are not shared between ubiquitous FSS and other services. However, this flexibility comes at the expense of providing less certainty for some services. For example, in large population centres where PTP and FWA may be considered the highest value use, ubiquitous FSS could be permitted to operate on a ‘no interference basis’. To minimise the risk of interference terminals could also be subject to other deployment restrictions. Outside of large populations centres, ubiquitous FSS (both fixed and ESIM) could have priority and therefore no restrictions on deployment, while PTP and FWA could operate on a ‘no protection’ basis to the FSS. Options 1b, 2 and 3 in this paper have possible variants that propose such sharing arrangements.

In terms of providing support for multiple services and operators, Options 2 and 3 are considered to maximise flexibility. While Options 1a and 1b also provide a high level of flexibility, the use of spectrum licensing arrangements in a segment of the band may not be optimal in the 28 GHz band. Option 4 offers the least amount of flexibility as it only provides support for the FSS.

### Principle 5—Balance the cost of interference and the benefits of greater spectrum utilisation

Based on the assessment of sharing and coexistence with incumbent FSS and PTP services contained in the *Consideration of Technical Issue* section of this paper, the ACMA considers that the cost of interference to incumbent users from proposed wireless broadband services is negligible. Furthermore, the outcome proposed under all options is that incumbent services can continue to operate in the band and would be provided protection from new services. Therefore, consideration of options against this principle can be concentrated on balancing the cost of interference and benefits of greater spectrum utilisation that arise from the introduction of new or expansion of existing services into the 28 GHz band.

The ability for FSS gateways and PTP to share spectrum is a well-established practice within several frequency bands. Due to the highly directional nature of PTP and FSS gateway antennas the cost of interference is also low. This also extends to coexistence with FSS satellite receivers.

Sharing between PTP and FWA is possible provided appropriate coordination procedures are put in place. Such arrangements have successfully been implemented in several other frequency bands. Furthermore, the ability of these services to share is expected to improve in mmWave bands due to propagation characteristics at these frequencies. However, due to the wide-beamwidth of FWA antennas coupled with the deployment of potentially hundreds of user terminals within a defined coverage area, there is a trade-off between increasing spectrum utilisation and managing interference. For high-density wide-area FWA deployments (similar to WWB) this is not considered an efficient trade-off. For lower density localised FWA deployments, provided there is enough spectrum to support a few PTP or FWA operators in an area, then the trade-off results in a good balance between managing interference and spectrum utilisation. This is considered to equally apply to sharing between FSS gateways and FWA, since FSS gateways are only transmitting in the 28 GHz band and like PTP also use high directional antennas. Options 1a, 1b, 2 and 3 provide arrangements for sharing between PTP (not in Option 3), FWA and FSS gateways.

Sharing between WWB and other terrestrial based services can be difficult unless there is suitable frequency or geographical separation. While operation within mmWave spectrum may facilitate a greater ability to share, it would increase the risk that a WWB operator would either be restricted in deploying base stations or could not deploy base stations in an area another service is already operating in. This is why spectrum licensing (or area-wide apparatus licensing) is usually considered appropriate for WWB use. Furthermore, providing arrangements for deployment of a high-density wide-area network could be considered as supporting greater spectrum utilisation. Option 1a and 1b provide such arrangements. It is noted that the arrangements for spectrum licensing under these options come at the expense of providing greater access to the band for FSS gateways and ubiquitous FSS. The coexistence between PTP and FWA is also a well-established practice within several frequency bands. However, due to the wide-beamwidth of FWA antennas coupled with the deployment of potentially hundreds of user terminals within a defined coverage area, there is a trade-off between increasing spectrum utilisation and managing interference.

The ability of WWB and FWA to share spectrum with FSS satellite receivers has been studied internationally by Task Group 5/1 of the ITU-R and domestically within an industry working group formed by the ACMA. As stated in the paper [*Future use of the 26 GHz band: Planning decisions and preliminary views*](https://www.acma.gov.au/theACMA/options-for-wireless-broadband-in-the-26-ghz-band), based on these studies, the ACMA is of the view that sharing is possible. However incumbent satellite operators were concerned that the (internationally agreed) parameters and assumptions that underpinned these studies might not be accurate estimates of actual WWB/FWA deployments. To safeguard against any potential divergence between assumed and actual operating conditions, the ACMA has proposed additional licence conditions for WWB or FWA use within satellite footprint areas in frequency segments that overlap with FSS. These additional conditions will be further refined within the technical liaison group that will be formed to develop spectrum licensing arrangements for access to the 26 GHz band. It is expected that any FSS satellite coexistence arrangements developed for the 26 GHz band will also be applicable to the 28 GHz band.

Sharing between ubiquitous FSS and PTP/FWA/WWB is possible under segregated spectrum and/or geographical arrangements. As discussed under Principle 4, further sharing on the same frequency and same/close geographic area may be possible if appropriate conditions for use are put in place. Further analysis and consultation with stakeholders will be required to determine appropriate arrangements to manage the residual risk of interference and associated resolution issues. This approach is considered under possible variants to Options 1b, 2 and 3.

Based on the above assessment, Options 1a, 1b provide the best balance under Principle 5, noting they also provide least access to spectrum for FSS of all the options. Options 2 and 3 provide the next best balance. However, as discussed under Principle 1, if it is considered that WWB is not one of the highest value uses of the 28 GHz band, then Option 2 and 3 would provide the best balance by default. Option 4 only provides arrangements for the FSS and given the ability of this service to share with others, it is considered to provide the least balance between use and interference management.

## Preferred options

Due to the similarity in issues across both the 26 GHz and 28 GHz bands, planning activities in both bands have been progressed largely in parallel. Consequently, it has been possible to consider planning arrangements across the entire 24.25-29.5 GHz range together. This has allowed for a more holistic assessment of the spectrum needs of the services vying for access to the band than would have been the case if they were considered in isolation.

As a result of the 2.4 GHz of spectrum identified for WWB use in the 26 GHz band, the ACMA considers that providing support for FSS, FWA and PTP would result in the highest value use of the 28 GHz band. In particular the satellite industry has made strong arguments regarding their existing and future spectrum needs in the 28 GHz band for both gateway and ubiquitous (including Earth Stations in Motion (ESIM)) uses.

By taking into account the outcomes of the 26 GHz band review and the assessment of options presented in this paper, the ACMA has identified Options 2 and 3 as its preferred options. Both options provide additional spectrum for FWA and satellite usage, with the key difference being whether future PTP services are accommodated in the band.

Table 5 and Figures 8 and 9 provide a summary of possible planning outcomes across the 26 GHz and 28 GHz bands assuming the planning decisions made in the 26 GHz band and the ACMA’s currently preferred options for the 28 GHz band.

Of note in the proposed arrangements across the entire 26 GHz and 28 GHz bands is the amount of spectrum being made available for FSS gateway, ubiquitous FSS and FWA use. This includes:

* The following amount of spectrum for FWA use:
* 0.8-1 GHz and up to 1.2 GHz (practically 1 GHz when taking into account the need for guard bands) of spectrum inside large population centres under Options 2 and 3 respectively;
* 2.8 GHz of spectrum outside of large population centres, noting this will be of interest to both FWA and WWB operators;
* The possible addition of an extra 0.8-1 GHz and up to 1.2 GHz (practically 1 GHz when taking into account the need for guard bands) of spectrum outside large population centres under Options 2 and 3 respectively. As access to this spectrum would be on a shared basis with ubiquitous FSS, such use would be on a ‘no protection’ basis for FWA.
* The following amount of spectrum for ubiquitous FSS use:
* 1.2 GHz and 1.4/1.6 GHz of exclusive FSS spectrum inside large population centres under Options 2 and 3 respectively – an increase of 600 MHz to 1 GHz;
* The possible addition of an extra 800 MHz and 400/600 MHz of spectrum inside large population centres under Options 2 and 3 respectively. As access to this spectrum would be on a shared basis with other services, deployment restrictions will need to be applied to ubiquitous FSS use to manage interference; and
* 2 GHz (the entire 28 GHz band) exclusive FSS spectrum outside of large population centres under both Options 2 and 3 - an increase of 1.4 GHz.
* The following amount of spectrum for FSS gateway use:
* 2 GHz of spectrum (the entire 28 GHz band) inside large population centres under Options 2 and 3 respectively—this maintains the status quo in the 28 GHz band. However, there is 500 MHz less spectrum available for new FSS gateways inside large population centres in the 27–27.5 GHz range;
* The possible addition of an extra 800 MHz and 400/600 MHz of spectrum inside large population centres under Options 2 and 3 respectively. As access to this spectrum would be on a shared basis with other services, deployment restrictions will need to be applied to ubiquitous FSS use to manage interference;
* 2.5 GHz (from 27–29.5 GHz) of spectrum outside of large population centres under both Options 2 and 3—this maintains current spectrum availability.

1. **The ACMA invites comment on its currently preferred options. Should other options be considered?**

To help inform its decision making, the ACMA also intends to run a separate consultation process on the viability of wide channel PTP arrangements in the 38 GHz band. This will be done in Q2 2019 with a decision expected by early Q3 2019.

Pending the outcome of this separate discussion process, the ACMA will decide on the future of PTP arrangements in the 28 GHz band. This along with feedback on all the issues presented in this paper will help inform which identified option or variant best meets the objective of maximising the overall public benefit from use of the band.

It is further noted that:

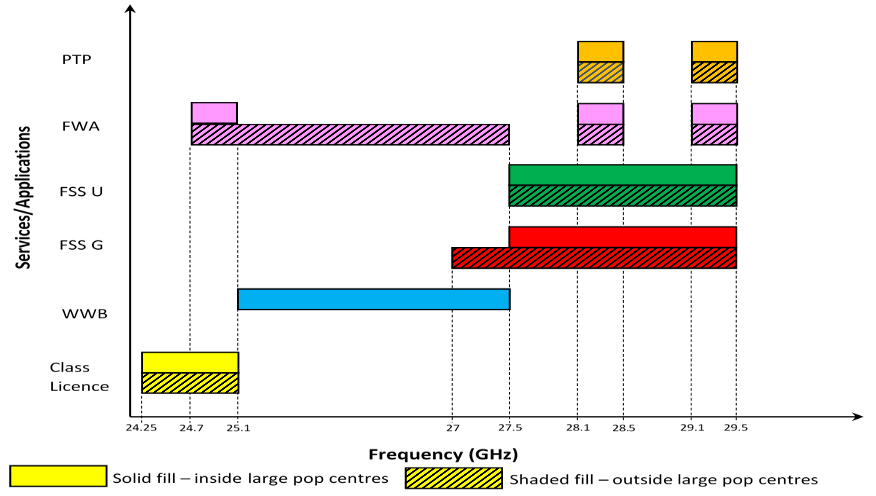
* the existing arrangements for body scanners defined in the [Radiocommunications (Low Interference Potential Devices) Class Licence 2015](https://www.legislation.gov.au/Details/F2018C00500) are considered to be appropriate and therefore will be maintained irrespective of the final planning option adopted for the 28 GHz band
* the existing arrangements in the frequency range 28.5 GHz to 29.1 GHz for the FSS are considered to be appropriate therefore will be maintained irrespective of the final planning option adopted for the 28 GHz band
* this paper is limited to considering options and arrangements for the FSS uplink in the 27.5–29.5 GHz band. Options for the associated FSS downlink segment (17.7–20.2 GHz band) are not included. The ACMA expects to undertake further work on the associated downlink segment, when the scope of changes required for the uplink segment are clear.

1. Summary of planning outcomes across the 26 GHz and 28 GHz bands for the two preferred options

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Scenario** | **FSS (Gateway)** | **FSS (ubiquitous)** | **WWB** | **FWA** | **PTP** | **Class Licence Broadband** |
| ***26 GHz decisions and***  ***28 GHz–*Option 2** | 27–27.5 GHz  Outside large population centres  27.5–29.5 GHz  Australia-wide | 27.5–28.1 GHz &  28.5–29.1 GHz  Australia-wide  28.1–28.5 GHz &  29.1–29.5 GHz   * Inside large population centres (restrictions apply)\*\* * Outside large population centres (no restrictions apply) | 25.1–27.5 GHz  Inside large population centres | 24.7–25.1 GHz  Australia-wide  25.1–27.5 GHz  Outside large population centres  28.1–28.5 GHz &  29.1–29.5 GHz   * Allocation inside large population centres * Allocation outside large population centres on a no protection basis from ubiquitous FSS\*\* | 28.1–28.5 GHz &  29.1–29.5 GHz   * Inside large population centres * Grandfather existing licences outside large population centres * Allocation outside large population centres for new licences on a no protection basis from ubiquitous FSS\*\* | 24.25–24.7 GHz  Australia-wide, limited to indoor use on private properties  24.7–25.1 GHz  Australia-wide, indoor and outdoor use permitted on private properties |
| ***26 GHz decisions and***  ***28 GHz—*Option 3** | 27–27.5 GHz  Outside large population centres  27.5–29.5 GHz  Australia-wide | 27.5–27.9/28.1 GHz   * Outside large population centres * Inside large population centres on a no protection basis to FWA\*\*   27.9/28.1–29.5 GHz  Australia-wide | 25.1–27.5 GHz  Inside large population centres | 24.7–25.1 GHz  Australia-wide  25.1–27.5 GHz  Outside large population centres  27.5–27.9/28.1 GHz   * Inside large population centres * Outside large population centres on a no protection basis from ubiquitous FSS\*\* | * Not supported * Existing licences grandfathered | 24.25–24.7 GHz  Australia-wide, limited to indoor use on private properties  24.7–25.1 GHz  Australia-wide, indoor and outdoor use permitted on private properties |

\*\* This is a possible variation to the option that could be considered

1. 26 GHz and 28 GHz planning arrangements—Option 2 scenario



1. 26 GHz and 28 GHz planning arrangements—Option 3 scenario

26 GHz and 28 GHz planning arrangements – Option 3 scenario 

# Invitation to comment

## Making a submission

The ACMA invites comments on the issues set out in this discussion paper or any other relevant issues.

* [Online submissions](http://www.acma.gov.au/theACMA/Consultations/Consultations) can be made via the comment function or by uploading a document. Submissions in Microsoft Word or Rich Text Format are preferred.
* Submissions by post—can be sent to:

The Manager, Spectrum Planning Section

Spectrum Planning and Engineering Branch

Communications Infrastructure Division

PO Box 78, Belconnen, ACT 2616

**The closing date for submissions is COB, Friday 17 May 2019.**

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

Publication of submissions

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

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

Privacy

[*Privacy and consultation*](https://www.acma.gov.au/theACMA/About/Corporate/Accountability/privacy-and-consultations) provides information about the ACMA’s collection of personal information during consultation and how we handle that information.

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

# Glossary

| **Term** | **Definition** |
| --- | --- |
| 1800 MHz band | Refers to the 1710–1785 / 1805–1880 MHz frequency range |
| 2.1 GHz band | Refers to the 1920–1980 / 2110–2170 MHz frequency range |
| 3.6 GHz band | Refers to the 3575–3700 MHz frequency range |
| 18 GHz band | Refers to 17.7-19.7 GHz frequency range |
| 22 GHz band | Refers to the 21.2–23.6 GHz frequency range |
| 26 GHz band | Refers to 24.25-27.5 GHz frequency range |
| 28 GHz band | Refers to the 27.5–29.5 GHz frequency range |
| 31 GHz band | Refers to the 31.0–31.3 GHz frequency range |
| 38 GHz band | Refers to the 37.5–39.5 GHz frequency range |
| 3GPP | 3rd Generation Partnership Project  An international body responsible for the standardisation of (cellular) mobile (including broadband) telecommunications, including the 2G, 3G, 4G and (soon) 5G technology standards. |
| (Spectrum or Service) Allocation | For the purposes of radiofrequency spectrum planning, an allocation is a specific range of frequencies allocated to use by one or more radiocommunications services within a band plan or spectrum plan. |
| Apparatus licence | An apparatus licence authorises, under the *Radiocommunications Act 1992*, the use of a radiocommunications device under a particular service type, in a particular frequency range and at a particular geographic location for a period of up to five years. |
| ASMG | Australian Spectrum Map Grid  Used to define geographical areas over which spectrum licences are issued. The HCIS is used to define the cells that make up the ASMG. The ASMG is described in detail in the document [The Australian spectrum map grid 2012](http://archive.acma.gov.au/webwr/_assets/main/lib410188/australian_spectrum_map_grid_28feb2012.docx).  *See also* HCIS. |
| CEPT | (Translated) European Conference of Postal and Telecommunications Administrations |
| Class licence | A standing authorisation for the operation of an unlimited number of devices operating within a set of conditions specified within the authorisation. |
| Coordination | The process of assessing the interference potential existing licensed services and a proposed new service will have on each other. Coordination is deemed to fail if the level of interference exceeds the specified protection criteria for the services involved. |
| Embargo | A spectrum embargo is a policy notice of intent by the ACMA to restrict the allocation of new licences in a particular frequency range to support replanning of that frequency range. Spectrum may still be able to be accessed on an exceptions basis through an application for an exemption to the embargo. |
| ESIM | Earth Stations in Motion |
| FCC | US Federal Communications Commission |
| FSS | Fixed satellite service |
| FWA | Fixed wireless access |
| GSO | Geostationary orbit |
| HVU | Highest value use  When applied to spectrum, is the use for which spectrum can provide the greatest incremental value to economic welfare. The value provided to the economy by spectrum is typically due to reduced costs for spectrum users to provide services, or the ability to provide new services that would not be possible without the use of particular spectrum. |
| International Telecommunication Union (ITU) | A specialised agency of the United Nations that is responsible for issues that concern information and communication technologies. The ITU coordinates the shared global use of radio spectrum and assists in the development of spectrum harmonisation arrangements. |
| NGSO | Non geostationary orbit |
| mmWave band | Any portion of radiofrequency spectrum in the frequency range 24.25-100 GHz |
| MNO | Mobile network operator |
| Principles for Spectrum Management | A set of principle developed by the ACMA to guide its approach to spectrum management. The key theme of the principles is that maximising the overall public benefit from use of the radiofrequency spectrum requires balanced application of both regulatory and market mechanisms. Details of the principles are available on the [ACMA website](http://www.acma.gov.au/theACMA/About/The-ACMA-story/Facilitating/decisionmaking-process-fyso-25-1). |
| PTP | Point-to-point |
| Spectrum licence | Issued under the *Radiocommunications Act 1992* and authorises the use of a particular frequency band within a particular geographic area for a period of up to 15 years. The geographic area can vary in size, up to and including the entire country. |
| WWB | wide-area wireless broadband |
| WISP | Wireless Internet Service Provider |

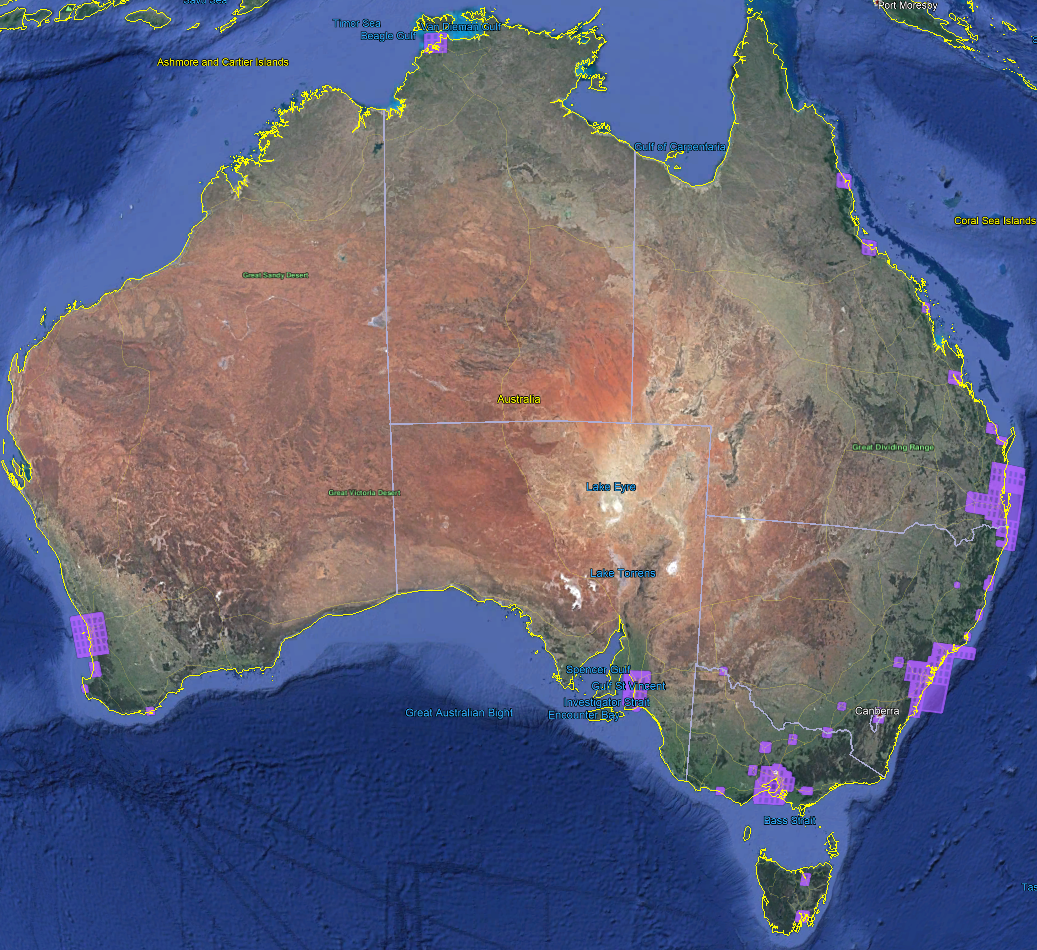
# Appendix A: Geographical area descriptions

Throughout this paper the term ‘large population centres’ is frequently used. Table 6 of this Appendix provides a detailed definition of the areas encompassed by this term and Figure 10 provides an illustration of it. These areas consist of towns/cities with populations greater than 50,000, as well as smaller towns/cities which are either holiday locations or have university campuses. The areas align with those proposed for spectrum licensing in the paper [*Future use of the 26 GHz band: Planning decisions and preliminary views*](https://www.acma.gov.au/theACMA/options-for-wireless-broadband-in-the-26-ghz-band).

The Australian Spectrum Map Grid (ASMG) is used to define geographical areas over which spectrum licences are issued. The Hierarchical Cell Identification Scheme (HCIS) is a naming convention developed by the ACMA that applies unique ‘names’ to each of the cells that make up the ASMG. The ASMG and HCIS are described in detail in the document, [*The Australian spectrum map grid 2012*](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/technical-framework-3_4-ghz).

The HCIS coordinates in Table 6 can be converted into a Placemark file (viewable in Google Earth) through a facility on the ACMA website: [www.acma.gov.au/theACMA/convert-hcis-area-description-to-a-placemark](http://www.acma.gov.au/theACMA/convert-hcis-area-description-to-a-placemark)

1. Illustration of the areas encompassed by the term ‘Large population centres’



1. HCIS description of ‘Large population centre’

| City Name | HCIS |
| --- | --- |
| Adelaide | IW3J, IW3K, IW3L, IW3N, IW3O, IW3P, IW6B, IW6C, IW6D, IW6F, IW6G, IW6H, IW3E5, IW3E6, IW3E8, IW3E9, IW3F4, IW3F5, IW3F6, IW3F7, IW3F8, IW3F9, IW3G4, IW3G5, IW3G6, IW3G7, IW3G8, IW3G9, IW3H4, IW3H5, IW3H6, IW3H7, IW3H8, IW3H9, IW3I2, IW3I3, IW3I5, IW3I6, IW3I8, IW3I9, IW3M2, IW3M3, IW3M5, IW3M6, IW3M8, IW3M9, IW6A2, IW6A3, IW6A5, IW6A6, IW6A8, IW6A9, IW6E2, IW6E3, IW6E5, IW6E6, IW6E8, IW6E9, IW6K1, IW6K2, IW6K3, IW6K4, IW6K5, IW6K6, IW6L1, JW1E4, JW1E7, JW1I1, JW1I4, JW1I7, JW1M1, JW1M4 |
| Albany | BW3P7, BW3P8, BW3P9, BW6D1, BW6D2, BW6D3, BW6D4, BW6D5, BW6D6, CW1M7, CW4A1, CW4A4 |
| Albury | LW8D, LW5P7, LW5P8, LW5P9, LW6M7, LW9A1, LW9A4, LW9A7 |
| Armidale | NU7G8, NU7G9, NU7K2, NU7K3 |
| Ballarat | KX2L, KX2G9, KX2H7, KX2H8, KX2H9, KX2K3, KX2K6, KX2K9 |
| Bathurst | MV8G, MV8F3, MV8F6, MV8F9, MV8J3, MV8K1, MV8K2, MV8K3 |
| Bendigo | KW9I5, KW9I6, KW9I8, KW9I9, KW9J4, KW9J5, KW9J6, KW9J7, KW9J8, KW9J9, KW9M2, KW9M3, KW9M5, KW9M6, KW9N1, KW9N2, KW9N3, KW9N4, KW9N5, KW9N6 |
| Brisbane | NT9, NT8C, NT8D, NT8G, NT8H, NT8K, NT8L, NT8O, NT8P, NU3A, NU3B, NU3C, NU3D, NU3F, NU3G, NU3H, NU3K, NU3L, NU3O, NU3P, NT5O4, NT5O5, NT5O6, NT5O7, NT5O8, NT5O9, NT5P4, NT5P5, NT5P6, NT5P7, NT5P8, NT5P9, NT6M4, NT6M5, NT6M6, NT6M7, NT6M8, NT6M9, NT6N4, NT6N5, NT6N6, NT6N7, NT6N8, NT6N9, NT6O4, NT6O5, NT6O6, NT6O7, NT6O8, NT6O9, NT6P4, NT6P5, NT6P6, NT6P7, NT6P8, NT6P9, NU2C1, NU2C2, NU2C3, NU2D1, NU2D2, NU2D3, NU2D5, NU2D6, NU2D8, NU2D9, NU2H2, NU2H3, NU3E1, NU3E2, NU3E3, NU3E5, NU3E6, NU3E8, NU3E9, NU3I2, NU3I3, NU3J1, NU3J2, NU3J3, NU3N3, NU3N6 |
| Bunbury | BV7G, BV7C4, BV7C5, BV7C6, BV7C7, BV7C8, BV7C9, BV7D4, BV7D5, BV7D7, BV7D8, BV7H1, BV7H2, BV7H4, BV7H5, BV7H7, BV7H8, BV7K1, BV7K2, BV7K3, BV7L1, BV7L2 |
| Bundaberg | NS8N, NS8M2, NS8M3, NS8M5, NS8M6, NS8M8, NS8M9, NT2A2, NT2A3, NT2B1, NT2B2, NT2B3 |
| Cairns | LQ1O, LQ1P, LQ1K7, LQ1K8, LQ1K9, LQ1L7, LQ1L8, LQ1L9, LQ4C1, LQ4C2, LQ4C3, LQ4C4, LQ4C5, LQ4C6, LQ4D1, LQ4D2, LQ4D3, LQ4D4, LQ4D5, LQ4D6 |
| Canberra | MW5E, MW4D6, MW4D9, MW4H3, MW4H9, MW4L3, MW5A4, MW5A5, MW5A6, MW5A7, MW5A8, MW5A9, MW5B4, MW5B7, MW5F1, MW5F4, MW5F7, MW5I1, MW5I2, MW5I3, MW5J1 |
| Coffs Harbour | NU9A, NU9E, NU8D9, NU8H3, NU8H6, NU8H9 |
| Darwin | GO7C, GO7D, GO7G, GO7H, GO7K, GO7L, GO8A, GO8E, GO8I |
| Hervey Bay | NT2C8, NT2C9, NT2D7, NT2D8, NT2D9, NT2G2, NT2G3, NT2G5, NT2G6, NT2H1, NT2H2, NT2H3, NT2H4, NT2H5, NT2H6 |
| Hobart | LY9N, LY9I8, LY9I9, LY9J7, LY9J8, LY9J9, LY9K7, LY9K8, LY9M2, LY9M3, LY9M5, LY9M6, LY9M8, LY9M9, LY9O1, LY9O2, LY9O4, LY9O5, LY9O7, LY9O8, LZ3A2, LZ3A3, LZ3B1, LZ3B2, LZ3B3, LZ3C1, LZ3C2 |
| Launceston | LY6E, LY5H3, LY5H6, LY5H9, LY5L3, LY5L6, LY6F1, LY6F4, LY6F7, LY6I1, LY6I2, LY6I3, LY6I4, LY6I5, LY6I6, LY6J1, LY6J4 |
| Lismore | NU3M3, NU3M6, NU3N1, NU3N2, NU3N4, NU3N5 |
| Mackay | MR8A, MR5M7, MR5M8, MR5M9 |
| Margaret River | AV9P6, AV9P9, AW3D3, BV7M4, BV7M5, BV7M7, BV7M8, BW1A1, BW1A2 |
| Melbourne | KX3J, KX3K, KX3L, KX3N, KX3O, KX3P, KX6B, KX6C, KX6D, KX6F, KX6G, KX6H, KX6J, KX6K, KX6L, LX1I, LX1M, LX1N, LX1O, LX4A, LX4B, LX4C, LX4E, LX4I, KX3F7, KX3F8, KX3F9, KX3G7, KX3G8, KX3G9, KX3H4, KX3H5, KX3H6, KX3H7, KX3H8, KX3H9, KX3M6, KX3M8, KX3M9, KX6A2, KX6A3, KX6A5, KX6A6, KX6A8, KX6A9, KX6E2, KX6E3, KX6E5, KX6E6, KX6E8, KX6E9, KX6I2, KX6I3, KX6I5, KX6I6, KX6I8, KX6I9, LX1E4, LX1E7, LX1E8, LX1E9, LX1J1, LX1J4, LX1J5, LX1J6, LX1J7, LX1J8, LX1J9, LX1K4, LX1K7, LX4F1, LX4F2, LX4F4, LX4F5, LX4F7, LX4F8, LX4J1, LX4J2, LX4J4, LX4J5, LX4J7, LX4J8 |
| Mildura | KW1A4, KW1A5, KW1A6, KW1A7, KW1A8, KW1A9, KW1E1, KW1E2, KW1E3 |
| Perth | BV1I, BV1J, BV1K, BV1L, BV1M, BV1N, BV1O, BV1P, BV2I, BV2J, BV2M, BV2N, BV4A, BV4B, BV4C, BV4D, BV4E, BV4F, BV4G, BV4H, BV4I, BV4J, BV4K, BV4L, BV5A, BV5B, BV5E, BV5F, BV5I, BV5J, BV1E7, BV1E8, BV1E9, BV1F7, BV1F8, BV1F9, BV1G7, BV1G8, BV1G9, BV1H7, BV1H8, BV1H9, BV2E7, BV2E8, BV2E9, BV2F7, BV2F8, BV2F9, BV4M1, BV4M2, BV4M3, BV4N1, BV4N2, BV4N3, BV4O1, BV4O2, BV4O3, BV4P1, BV4P2, BV4P3, BV5M1, BV5M2, BV5M3, BV5N1, BV5N2, BV5N3 |
| Port Macquarie | NV2H, NV2L1, NV2L2, NV2L3 |
| Rockhampton | MS6F, MS6G, MS6B7, MS6B8, MS6B9, MS6C7, MS6C8, MS6C9, MS6J1, MS6J2, MS6J3, MS6K1, MS6K2, MS6K3 |
| Shepparton-Mooroopna | LW7F, LW7G1, LW7G4, LW7G7, LW7J1, LW7J2, LW7J3, LW7K1 |
| Sunshine Coast | NT5G, NT5H, NT5K, NT5L, NT6E, NT6F, NT6G, NT6H, NT6I, NT6J, NT6K, NT6L, NT5C4, NT5C5, NT5C6, NT5C7, NT5C8, NT5C9, NT5D4, NT5D5, NT5D6, NT5D7, NT5D8, NT5D9, NT5O1, NT5O2, NT5O3, NT5P1, NT5P2, NT5P3, NT6A4, NT6A5, NT6A6, NT6A7, NT6A8, NT6A9, NT6B4, NT6B5, NT6B6, NT6B7, NT6B8, NT6B9, NT6C4, NT6C5, NT6C6, NT6C7, NT6C8, NT6C9, NT6D4, NT6D5, NT6D6, NT6D7, NT6D8, NT6D9, NT6M1, NT6M2, NT6M3, NT6N1, NT6N2, NT6N3, NT6O1, NT6O2, NT6O3, NT6P1, NT6P2, NT6P3 |
| Sydney | NW1, MV9I, MV9J, MV9K, MV9L, MV9M, MV9N, MV9O, MV9P, MW3C, MW3D, MW3G, MW3H, MW3K, MW3L, MW3O, MW3P, MW6C, MW6D, NV4N, NV4O, NV4P, NV5M, NV5N, NV5O, NV5P, NV7B, NV7C, NV7D, NV7E, NV7F, NV7G, NV7H, NV7I, NV7J, NV7K, NV7L, NV7M, NV7N, NV7O, NV7P, MV9D6, MV9D9, MV9E4, MV9E5, MV9E6, MV9E7, MV9E8, MV9E9, MV9F4, MV9F5, MV9F6, MV9F7, MV9F8, MV9F9, MV9G4, MV9G5, MV9G6, MV9G7, MV9G8, MV9G9, MV9H3, MV9H4, MV9H5, MV9H6, MV9H7, MV9H8, MV9H9, MW3B2, MW3B3, MW3B5, MW3B6, MW3B8, MW3B9, MW3F2, MW3F3, MW3F5, MW3F6, MW3F8, MW3F9, MW3J2, MW3J3, NV4I5, NV4I6, NV4I8, NV4I9, NV4J4, NV4J5, NV4J6, NV4J7, NV4J8, NV4J9, NV4K4, NV4K5, NV4K6, NV4K7, NV4K8, NV4K9, NV4L4, NV4L5, NV4L6, NV4L7, NV4L8, NV4L9, NV4M2, NV4M3, NV4M5, NV4M6, NV4M8, NV4M9, NV5I4, NV5I5, NV5I6, NV5I7, NV5I8, NV5I9, NV5J4, NV5J5, NV5J6, NV5J7, NV5J8, NV5J9, NV5K4, NV5K5, NV5K6, NV5K7, NV5K8, NV5K9, NV5L4, NV5L5, NV5L6, NV5L7, NV5L8, NV5L9, NV7A2, NV7A3, NV7A4, NV7A5, NV7A6, NV7A7, NV7A8, NV7A9 |
| Toowoomba | NT7H, NT7L, NT8E, NT8F, NT8I, NT8J, NT7G2, NT7G3, NT7G5, NT7G6, NT7G8, NT7G9, NT7K2, NT7K3, NT7K5, NT7K6, NT7K8, NT7K9, NT7O2, NT7O3, NT7O5, NT7O6, NT7P1, NT7P2, NT7P3, NT7P4, NT7P5, NT7P6, NT8M1, NT8M2, NT8M3, NT8M4, NT8M5, NT8M6, NT8N1, NT8N2, NT8N3, NT8N4, NT8N5, NT8N6 |
| Townsville | LR2C, LR2D, LR2G, LR2H |
| Traralgon-Morwell | LX5A6, LX5A8, LX5A9, LX5B4, LX5B5, LX5B6, LX5B7, LX5B8, LX5B9, LX5C4, LX5C5, LX5C7, LX5C8, LX5F1, LX5F2, LX5F3, LX5G1, LX5G2 |
| Tuncurry-Forster | NV5B6, NV5B9, NV5C4, NV5C5, NV5C7, NV5C8, NV5F3, NV5G1, NV5G2 |
| Wagga Wagga | LW6B |
| Warrnambool | KX4F2, KX4F3, KX4F5, KX4F6, KX4F8, KX4F9, KX4G1, KX4G2, KX4G4, KX4G5, KX4G7, KX4G8 |

1. mmWave bands incorporate any portion of the radiofrequency spectrum in the frequency range 24.25-100 GHz [↑](#footnote-ref-2)
2. This process mirrors the *Stages and considerations for band re-farming* defined in the [ACMA’s mobile broadband strategy](https://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/Mobile-broadband/mobile-broadband-strategy-and-work-plan) [↑](#footnote-ref-3)
3. ACMA [*Corporate plan 2018–19*](https://www.acma.gov.au/theACMA/acma-corporate-plan) [↑](#footnote-ref-4)
4. Area-wide apparatus licences can also be issued. [↑](#footnote-ref-5)
5. Technical details and limitations include maximum power, frequency range, out-of-band emissions limits, and geographical licence area. [↑](#footnote-ref-6)
6. The [draft 2018–22 FYSO](https://www.acma.gov.au/theACMA/draft-five-year-spectrum-outlook-2018-22) details the current status of work in the 26 GHz and 60 GHz bands, as well as providing a list of bands currently at the *monitoring* stage. [↑](#footnote-ref-7)
7. World Radiocommunications Conference-2019 [↑](#footnote-ref-8)
8. Earth Stations in Motion [↑](#footnote-ref-9)
9. High Altitude Platform Stations [↑](#footnote-ref-10)
10. A spectrum-space apparatus licence is a proposed new type of apparatus licence that is currently being considered by the ACMA. To create this new licence type would require amendment to several legislative instruments made and administered by the ACMA and will be subject to a separate consultation process if the ACMA decides to go ahead with developing this licence type. It is intended to be very similar to a spectrum licence in that it has the following attributes: area-wide (i.e. can authorise one or multiple stations), purpose-agnostic, frequency-agnostic, boundary coordinated, scalable, and issue-process agnostic. [↑](#footnote-ref-11)
11. Existing facilities are located at New Norcia, WA, and Tidbinbilla, ACT. [↑](#footnote-ref-12)
12. CEPT Roadmap for 5G, version 7, revised 26 October 2018 [↑](#footnote-ref-13)
13. <https://www.theverge.com/2018/11/14/18095020/fcc-auction-mmwave-5g-spectrum-mobile-network> [↑](#footnote-ref-14)
14. <https://www.acma.gov.au/theACMA/class-licensing-updates-supporting-5g-and-other-technology-innovations> [↑](#footnote-ref-15)
15. Refer to [RALI FX 3](https://www.acma.gov.au/theACMA/rali-fx3-microwave-fixed-services-frequency-coordination) for full details on existing arrangements [↑](#footnote-ref-16)
16. European Conference of Postal and Telecommunications Administrations [↑](#footnote-ref-17)
17. ‘Australia could host ground infrastructure for next-gen Viasat satellite’, computerworld, 8 February 2019, <https://www.computerworld.com.au/article/657535/australia-could-host-ground-infrastructure-next-gen-viasat-satellite/> [↑](#footnote-ref-18)
18. Very small aperture terminal [↑](#footnote-ref-19)
19. European, Middle East and Africa [↑](#footnote-ref-20)
20. Non-geostationary orbit [↑](#footnote-ref-21)
21. Geostationary orbit [↑](#footnote-ref-22)
22. Refer ACMA Business Operating Procedures [Licensing procedures for ESIMs communicating with GSO space stations in the FSS  in 19.7–20.2 GHz and 29.5–30.0 GHz](https://www.acma.gov.au/-/media/Licence-Issue-and-Allocation/Information/Word-Document/BOP-ESIMs-2017-docx.docx?la=en)  and [Interim Licensing procedures for ESIMs communicating with GSO/NGSO space stations in the FSS in part of the Ka Band](https://www.acma.gov.au/-/media/Spectrum-Engineering/Information/Word-Document/Interim-BOP-GSO-NGSO-ESIM-docx.docx?la=en) [↑](#footnote-ref-23)
23. In this figure FSS U refers to ubiquitous FSS and FSS G refers to FSS gateways [↑](#footnote-ref-24)
24. In this figure FSS U refers to ubiquitous FSS and FSS G refers to FSS gateways [↑](#footnote-ref-25)
25. In this image FSS U refers to ubiquitous FSS and FSS G refers to FSS gateways [↑](#footnote-ref-26)
26. In this image FSS U refers to ubiquitous FSS and FSS G refers to FSS gateways [↑](#footnote-ref-27)
27. AMTA State of the Industry Report, [Mobile Nation: The economic and social impact of mobile technology](http://www.amta.org.au/files/Mobile.nation.The.economic.and.social.impact.of.mobile.technology.pdf), Deloitte Access Economics, Feb 2013 [↑](#footnote-ref-28)
28. AMTA State of the Industry Report, [5G Mobile - enabling businesses and economic growth](http://www.amta.org.au/files/deloitte-access-economics-5g-mobile-enabling-businesses-and-economic-growth-pdf), Deloitte Access Economics, October 2017 [↑](#footnote-ref-29)
29. [Impacts of 5G on productivity and economic growth](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=2ahUKEwipqNSanf7gAhVIbn0KHbV0C1kQFjACegQICBAC&url=https%3A%2F%2Fwww.communications.gov.au%2Ffile%2F35551%2Fdownload%3Ftoken%3D0MlSFttv&usg=AOvVaw3_vwXV0KUfwecI2PV-aIfJ), Bureau of Communications and Arts Research, April 2018 [↑](#footnote-ref-30)
30. While the Option 3 allocation appears to provide an 800 MHz allocation to FWA, due to the need for guard bands with the adjacent band ubiquitous FSS use as well as alignment with the existing PTP arrangements, a total of six 112 MHz channels are available. [↑](#footnote-ref-31)
31. Microwave fixed point-to-point services assignment statistics: 1 January 2008 to 1 January 2012. SP 2014/04, <https://www.acma.gov.au/-/media/Spectrum-Engineering/Issue-for-comment/IFC-31-2014/Word/SPP-201404-Rali-FX-3-stats_FINAL-docx.DOCX?la=en> [↑](#footnote-ref-32)