TELSTRA CORPORATION LIMITED

Wireless broadband in the 26 GHz band

Public submission

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EXECUTIVE SUMMARY

We welcome the opportunity to comment on the ACMA's option paper *Wireless broadband in the 26 GHz band*. The development of fifth generation mobile broadband (5G) is a step change in technology and represents an incredible opportunity for national productivity gains and economic development.

Option 2d provides certainty for investment to deliver 5G in the 26 GHz band

In order to provide licensees with the required spectrum certainty so they can make the necessary investments in 5G technology in this band, and to have the required control over the quality of service offered, the 'defined regions' should be allocated via exclusive spectrum licensing for Type 1 (spectrum licensed) services, i.e., Option 2d. We note that configuring the 'defined regions' for Type 1 services is optimal because it will allow network operators to deploy networks in an unencumbered and coordinated way, delivering the greatest benefit to Australians and to Australia's economy, and allowing the band to realise its 'highest value use'.

The ACMA considers Option 4d, which allows for an 'underlay of class licensed devices', to be the '*default preferred option*' based on preliminary assessment against the Principles for Spectrum Management[1]. However, we have concerns that an underlay of class licensed devices has the potential to cause interference to conventional mobile networks (Type 1 services), thereby undermining the property rights of future spectrum licensees. We do not support Option 4, including permutations such as indoor-only use of class licensed devices. Instead, we propose a variation to Option 2d, which is to introduce a lower band edge of 24.7 GHz for Type 1 deployment, below which, Type 2 (apparatus licensed) or Type 3 (class licensed) devices could be considered.

We further believe there should be approximately 24 'defined regions' so that all towns in Australia with a population of approximately 50,000 or more (representing approximately 80% of the national population) would be covered by this arrangement. Beyond this point, apparatus licensing should be workable insofar as the volume of apparatus licences will be manageable administratively.

Ka band satellites and IMT can coexist in 27.0-27.5 GHz.

The Australian study[2] submitted to ITU-R Task Group 5/1 (TG 5/1) showed that the aggregate interference from IMT devices into Fixed Satellite Service (FSS) uplinks operating in 27.0-27.5 GHz portion of the band is some 32 dB below the required protection levels for FSS, using standard IMT-2020 input parameters for the number of simultaneous user devices, base stations, densities and network loading factors. 32 dB is a significant margin, and to put this in context, it means that the number of IMT devices operating within an FSS beam could be increased by a factor of 1500 above the input parameters for user device and base station density used in the TG 5/1 coexistence studies, while still maintaining protection of FSS uplinks.

We note that nbn has proposed alternate input assumptions to the ACMA's Working Group on 26 GHz Inter-Service Coexistence to those used in the Australian study, however, we are of the view that the assumptions proposed by nbn do not reflect a real-world scenario, and as such, should be treated accordingly by the ACMA when making decisions on coexistence.

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[1] ACMA Consultation Paper, "Wireless Broadband in the 26 GHz band", top of page 56.
[2] Document 5-1/290-E, Sharing study for IMT systems in the 24.25-27.5 GHz frequency range with FSS. 19 April, 2018.

Protection for EESS can be managed so that the entire band can be reallocated

We support protection for Earth Exploration Satellite Services (EESS) operating in the adjacent 23.6-24.0 GHz band. We note the work of the Global mobile Suppliers Association (GSA), and support their conclusion[3] that based on currently available compatibility studies, out-of-band emission limits of -33 dBW/(200 MHz) for base stations and -31 dBW/(200 MHz) for user equipment are required. This will require a lower band edge of 24.7 GHz for outdoor deployments, and provides a useful reservation of spectrum below 24.7 GHz that can be considered for Type 2 (apparatus licensed) or Type 3 (class licensed) devices.

Early Access in 2019

We maintain our position that the remaining stage of the 26 GHz band reallocation process and the auction must continue to be the ACMA's highest priority and that these activities must be conducted as expeditiously as possible. Without timely access to the 26 GHz band under a spectrum licensed allocation, Australia risks falling behind its global peers in deploying 5G.

Finally, we have previously provided detail of an early access mechanism[4] that would allow future 5G providers to gain early access to spectrum in the 26 GHz band, given the ACMA's deferral of the 26 GHz auction to 2020. Access to this band is critical for being able to deliver the fastest broadband services that 5G is capable of delivering (up to around 10x faster than that possible in 3.6 GHz) and we expect commercial deployments of 5G services in the band will be possible in 2019. Access to 26 GHz spectrum needs to be made available as quickly as possible in 2019 for Australia to remain at the forefront of technological innovation. We are asking the ACMA to make at least the upper 1.5 GHz of the band available under a temporary apparatus licensing approach that would provide spectrum seekers with equitable access in a pragmatic and administratively simple manner.

[3] Doc. ECC(18)091, ECC Decision/CEPT Report for 26 GHz: Protection of passive services below 24 GHz, 27 June, 2018. https://cept.org/Documents/ecc/44734/ecc-18-091_gsa-26-ghz-passive-services-protection

[4] Telstra Submission to ACMA FYSO18-22, section 2.1, page 9. https://www.acma.gov.au/-/media/Spectrum-Review-Implementation-Taskforce/Issue-for-comment/IFC-12-2018/Telstra---FYSO-submission-pdf.pdf

01 Introduction

We welcome the opportunity to comment on the ACMA's option paper *Wireless broadband in the 26 GHz band*. This consultation occurs as part of the *preliminary replanning* stage in the ACMA's four-stage process to reallocate a radio-spectrum band. Specifically, this stage explores options around how the band should be allocated for future use. The ACMA seeks input from a diverse range of current and future stakeholders in the band, and we are pleased to be able to contribute to the shaping of the band for future use.

The recent Deloitte report[5] on 5G mobile technology projects that by 2030, the benefit to the Australian economy from 5G networks could be up to 0.2% of GDP per year, equating to $1,300-$2,000 additional GDP per person or $50 billion additional GDP across the population. It is essential that the ACMA and Australian Government continue to work to pave the way for the introduction of 5G technology into Australia in order for Australia to remain at the forefront of technology innovation.

Our submission is structured as follows:

- Section 2 outlines our support for a variation on Option 2d; and
- Section 3 contains specific responses to the questions posed in the consultation.

02 New deployment paradigm for 5G in mmWave bands

A key feature of 5G network deployment in mmWave bands will be the use of small cells. As the ACMA's consultation paper observes, ITU-R Task Group 5/1 considers that 99 per cent of user devices will be less than 130m from a base station for suburban deployments.[6] This densification of the network must be underpinned by a spectrum licensing regime that removes unnecessary administrative overhead associated with lodging thousands of apparatus licence applications, and we are pleased to see the ACMA has given consideration to spectrum licensing in the band for all eight state and territory capital cities as well as a further eight major regional centres.

In the following paragraphs we make a number of general comments about how we believe the proposed configuration of the spectrum in the 26 GHz band could be improved to ensure the greatest utility is realised.

2.1. Additional geographies will benefit regional communities

The sixteen regions proposed by the ACMA in the consultation paper cover 23 of the 31 Australian cities with a population over 50,000 (see Appendix 1 for details). We propose that a further eight regional centres be added to the defined geographic regions such that all Australian cities with populations over 50,000 are afforded dedicated, spectrum licensed 26 GHz band spectrum for Type 1[7] (i.e., conventional wide-area mobile network) use. Cities with a population of over 50,000 are likely to be well serviced by

[5] Deloitte. "*5G Mobile Technology – Are businesses ready to seize the opportunity?*" Sept 2018. Page i. https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-5g-mobile-technology-170918.pdf

[6] Distribution of UE's within a cell, used in ITU-R sharing studies, can be found in Annex 1 of the TG 5/1 chairman's report.

[7] ACMA Consultation Paper, "Wireless Broadband in the 26 GHz band", page 8.

nbn deployment upon its completion, and so the proposition that spectrum should be reserved in such locations for Type 2 (Fixed Wireless/Apparatus Licenced) use is less compelling. Hence, we posit that the utility of the band is maximised by allocating the band for Type 1 (spectrum licensed) services in these locations.

Our proposed threshold of having spectrum licensing covering towns with a population of 50,000 or more means that approximately 80% of the Australian population would be covered by a spectrum licensing arrangement for the 26 GHz band. This threshold provides a reasonable balance between the number of spectrum regions (24) and the extent to which apparatus licensing would be workable outside spectrum licensed regions.

Fewer spectrum licensed regions would lead to ever escalating numbers of apparatus licensed base stations (particularly considering the small coverage area per base station), and the ACMA's suggestion that area-wide apparatus licences can be issued will only go some of the way to resolving this. Less reliance on apparatus licences (even area-wide licences) will reduce administrative overheads and coordination complexity between area adjacent licensees.

While even more spectrum licensed regions could be considered, this would add complexity to the auction, and there are diminishing returns from further reducing of the quantity of apparatus licences that mobile network operators would require.

We expect 5G will also be rolled out to cities with populations below 50,000, and support the ACMA's position that this can be well serviced through a Type 2 (apparatus licensed) approach.

Note that for our proposal, the specific population thresholds, and the exact size and location of boundaries of the additional regional areas suggested for spectrum licensing are preliminary only, and should be finessed with further market analysis.

2.2. 27.0-27.5 GHz should be included for spectrum licensing in the defined regions

ITU-R Task Group 5/1 (TG 5/1) has been conducting studies into the coexistence of Ka band FSS satellites and IMT in the 27.0-27.5 GHz segment of the band. The Australian study[8] submitted to TG 5/1 showed that the aggregate interference from IMT devices into Fixed Satellite Service (FSS) uplinks operating in 27.0-27.5 GHz portion of the band is some 32 dB below the required protection levels for FSS, using standard IMT-2020 deployment parameters for the number of simultaneous user devices, base stations, densities and network loading factors. 32 dB is a significant margin, and to put this into perspective, this would allow for a factor of 1500 increase above the input parameters for user device and base station density used in the TG 5/1 coexistence studies[9], while still maintaining protection of FSS uplinks.

The conclusion from TG 5/1, contained in section 2.1.3 of the chairman's report[10], states that in the case of IMT causing interference to FSS space stations, "*All studies show that sharing is feasible when using the baseline parameters*." The preceding section (2.1.2) notes that several studies also conducted sensitivity analysis using parameters beyond those provided for in the guidance developed by the ITU-R on how to use the parameters provided in sharing and compatibility studies. Sensitivity analysis included

[8] Document 5-1/290-E, Sharing study for IMT systems in the 24.25-27.5 GHz frequency range with FSS. 19 April, 2018.
[9] Attachment 2 to TG 5/1 Document 5-1/36, Feb 2017. https://www.itu.int/md/R15-TG5.1-C-0036/en
[10] Task Group 5/1 Chairman's Report, "**Sharing and Compatibility of the FSS and IMT Operating in the 24.25-27.5 GHz Frequency Range**". 20 Sept, 2018.

one or more of the following deviations from standard parameters: denser IMT deployments, higher network loading, higher IMT base station conducted power or EIRP, higher FSS boresight elevation angles or higher UE height. While all of these studies observed increases in the levels of interference, none of them exceeded the FSS protection criteria of -10.5 dB *I/N* exceeded up to 20% for the long-term (i.e., *I/N* average) or for the short term, -6 dB *I/N* exceeded 0.6% and 0 dB *I/N* exceeded 0.02% of time. In short, no credible studies have been carried out that challenge the conclusion from the TG 5/1 studies, which clearly show that sharing between IMT and FSS will be easily achieved.

We note that nbn has proposed alternate input assumptions to the ACMA's local Working Group on 26 GHz Inter-Service Coexistence to those used in the Australian study submitted to TG 5/1, however, we are of the view that the assumptions proposed by nbn do not reflect a real-world scenario, and as such, should be treated with caution by the ACMA when making decisions on coexistence.

2.3. The lower edge of the band should be 24.7 GHz

At the other end of the band, Earth Exploration Satellite Services (EESS) operate in the adjacent 23.6-24.0 GHz band, and require protection against out-of-band emissions from devices operating in adjacent or nearby bands.

We note the work of the Global mobile Suppliers Association (GSA), and support their conclusion[11] that based on currently available compatibility studies, out-of-band emission limits of -33 dBW/(200 MHz) for base stations and -31 dBW/(200 MHz) for user equipment are required. As was noted by the ACMA's Working Group on Inter-Service Coexistence, this will require a lower band edge of 24.7 GHz for outdoor deployments, and provides an ideal reservation of spectrum for Type 2 (apparatus licensed) or Type 3 (class licensed) devices to be considered.

As the ACMA's consultation notes[12], further studies are required to understand the domestic planning arrangements that will need to be applied in the lower part of the 26 GHz band to ensure out-of-band emission limits are met. Ultimately, deployment in the bottom part of the band will be influenced by the level of emissions able to be tolerated in the 23.6-24.0 GHz band, and the ability of network and user equipment to manage (reduce) out-of-band emissions through techniques including:

- use of high performance filters;
- reducing power output levels,
- indoor deployment; or
- managing the density of deployment

to ensure aggregate emissions into the EESS band remain below the regulated threshold.

The forthcoming WRC-19 will further refine the necessary protection levels for EESS through the completion of further compatibility studies, and future evolution in filter technology and/or beam steering will also assist in reducing out-of-band emissions and therefore, interference levels into frequency adjacent EESS.

For now, we recommend the lower band edge for widespread outdoor mobile deployments should be set to 24.7 GHz to protect EESS in the 23.6-24.0 GHz band.

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11 Doc. ECC(18)091, ECC Decision/CEPT Report for 26 GHz: Protection of passive services below 24 GHz, 27 June, 2018. https://cept.org/Documents/ecc/44734/ecc-18-091_gsa-26-ghz-passive-services-protection

12 Section on Passive Earth Sensing, pages 32-34.

2.4. GSMA and ITU-R guidance is for around 1 GHz per MNO

The GSMA recently published its 5G Spectrum Public Policy Position[13], containing a series of policy statements intended for governments, regulators and the mobile industry to work together on to make 5G technology successful. The first of the policy statements relates to the amount of spectrum required in both mid and mmWave bands. The GSMA's policy is that governments should aim to allocate around 1 GHz per operator to ensure that the full potential of 5G mobile broadband can be realised.

Twelve months earlier, the ITU-R published its report on the minimum requirements related to technical performance for IMT-2020 radio interface(s)[14]. Section 4.13 notes that the technical capabilities for the Radio Interface Technology (RIT) must include support for up to 1 GHz for radios operating in bands above 6 GHz, ensuring that vendor equipment will similarly support 1 GHz capabilities, most likely across multiple channels.

As we stated in the previous section, to protect EESS in the 23.6-24.0 GHz band, the lower band edge should be placed at 24.7 GHz. This leaves only 2.8 GHz through to an upper edge of 27.5 GHz, which is already insufficient for three network operators to each obtain 1 GHz of spectrum in line with the GSMA policy and ITU-R reports. As such, it is essential the upper band edge be set at 27.5 GHz to avoid any further deviation from the 1 GHz per operator target.

2.5. A variation of Option 2d should be adopted

We strongly recommend the ACMA proceed with Option 2d, exclusive spectrum licensing in the defined regions with a lower band edge of 24.7 GHz and with the additional eight defined regions. Spectrum licensing within the defined regions will provide the certainty for 5G mobile network operators to invest in good quality coverage, high throughput services without the need to coordinate either with other (apparatus licensed) users in a portion of the band, or with an underlay of class licensed services.

The ACMA has stated that the '*default preferred option*' is Option 4d[15], based on preliminary assessment against the Principles for Spectrum Management. Option 4d proposes an underlay of class-licensed devices that could coexist across part or all of the band. We do not support this option, including permutations on the option, such as limiting class licensed device use to indoor only. In the first instance, it is highly likely that operators of 5G mobile broadband networks will want to use indoor deployment in the 26 GHz band, especially in public indoor places such as shopping malls, public transport facilities such as train stations, office buildings and more. A co-channel class licence arrangement diminishes the property rights of the spectrum licensee by introducing high levels of uncertainty, because class licences are technology agnostic so it is not possible to predict the types of technology or proliferation that could emerge and then have to coexist with 5G technology.

Given the lower band edge for the 26 GHz band needs to be set to 24.7 GHz for outdoor deployments to meet GSA out-of-band emission limits[16], we propose that the 450 MHz in the range 24.25-24.7 GHz

[13] GSMA 5G Spectrum Policy Position. 6 Nov 2018. https://www.gsma.com/spectrum/5g-spectrum-policy-position/
[14] ITU-R Report M.2410-0, Nov 2017. https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-M.2370-2015-PDF-E.pdf
[15] ACMA Consultation Paper, "Wireless Broadband in the 26 GHz band", top of page 56.
[16] -33 dBW/(200 MHz) for base stations and -31 dBW/(200 MHz) for user equipment

provides useful reservation of spectrum below 24.7 GHz for Type 2 (apparatus licensed) or Type 3 (class licensed) devices to be considered.

To be clear though, we are not recommending that the 450 MHz segment is rigidly allocated for apparatus or class licensed services at this time. Rather, we are saying that for the time being, the bottom 450 MHz should not be allocated to any specific service type (Type 1, 2 or 3), until there is more certainty about the demand for services that could use this spectrum and subject to those services not causing interference to EESS.

Outside the defined regions, we support the ACMA's proposal that the remainder of the country is apparatus licensed. This could include an underlay of class licensed devices, if required.

For completeness, we propose that incumbents such as FSS should be able to continue operating in the band. Given TG 5/1 coexistence studies show that aggregate interference levels from IMT-2020 services are well below the protection thresholds required to protect FSS services, we see no impediment to the deployment of new FSS services. Outside of the defined regions, we see such deployment occurring through the use of apparatus licences. Assuming the ACMA proceeds with reallocating the 27.0-27.5 GHz portion of the band under a spectrum licensing regime in the defined regions, we propose that new FSS services in this segment be authorised through third-party agreements with the spectrum licensees.

There are currently no apparatus licensed point-to-point (P2P) services operating in the 26 GHz band, and our view is that reallocation for spectrum licensing in the defined regions would not cause any detriment by preventing future apparatus licensing. We see no concerns with allowing P2P services to be introduced outside the defined regions where Type 2 wireless broadband services will be deployed under an apparatus licensing model.

2.6. Apparatus licensing approach outside the defined regions

The consultation[17] notes that area-wide apparatus licences can be issued. We recommend that allowing area-wide apparatus licences in regional areas for this band would be a pragmatic approach to balancing the number of licence applications required for small cell coverage of an area without creating underutilised spectrum locations. We propose that a Level 1 HCIS identifier[18] would be the appropriate size for area-wide apparatus licences. Level 1 HCIS identifiers are cells with 5 arcminutes of latitude and longitude. 5 arcminutes is approximately 9.2 km in length, and as such, a Level 1 cell represents an area of just under 86 km^2 (roughly 21,200 acres). Of course, not all regional towns are in the very centre of a Level 1 HCIS identifier, and so it is likely that deployment in some regional towns could require a few adjacent area-wide apparatus licences.

2.7. Early Access

With progress now well underway for reallocating the 3.6 GHz band, we maintain that every urgency must now be given to reallocation of spectrum in the 26 GHz band if Australia is to keep pace with international 5G developments and avoid any delay in realising the benefits of this next evolution in

[17] Page 12, footnote 6.
[18] The Australian spectrum map grid 2012, February 2012. https://www.acma.gov.au/-/media/Spectrum-Engineering/Information/pdf/The-Australian-spectrum-map-grid-2012.PDF?la=en

mobile technology. We are expecting commercial network and user devices to become available for this band during 2019, meaning that commercial deployments of 5G services in the band will be possible in 2019. We trust that the remaining stage of the 26 GHz band reallocation process and an auction will continue to be the ACMA's highest priority and that these activities will be conducted as expeditiously as possible.

That said, we recognise the challenges the ACMA has had in maintaining the schedule for an auction of the 26 GHz band, and note the revised timing for the 26 GHz allocation as conveyed in the FY18-22 FYSO. It is in this light that we have given further thought to an early access mechanism that could allow future 5G providers to gain early access to spectrum in the 26 GHz band. In our response to the FY18-22 FYSO[19], we proposed two options: either an initial auction of the upper part of the band while EESS issues are resolved; or early commercial access via special temporary apparatus licences.

The consultation[20] notes that "*It remains the ACMA's preference for the 26 GHz band to be allocated through a single process*…", which we agree with and support. At the same time, access to 26 GHz spectrum needs to be made available as quickly as possible in order for Australia to remain at the forefront of technology innovation. We are asking the ACMA to make at least the top 1.5 GHz of the band available under a temporary apparatus licensing approach that would provide spectrum seekers with equitable access in a pragmatic and administratively simple manner. Block sizes should be aligned with 3GPP Release 15 channel sizes, and apparatus licences would automatically expire at the conclusion of the formal allocation of the band (commencement of spectrum licences)

Clear licence conditions would ensure that no licensee could claim that they had any expectation of ongoing rights to use that spectrum, or could make any claims for economic loss or costs resulting from investments they had made to use that spectrum. Setting the licence expiry date to coincide with the conclusion of the allocation (commencement of spectrum licences) means that successful bidders would need to retune or switch off any existing apparatus licenced equipment to align with the spectrum licence outcomes by, at latest, the date the spectrum licences commence. This also ensures that the temporary apparatus licences do not prejudice the auction.

This temporary licensing arrangement needs to be made available for applications as early as possible in 2019, so that operators can take advantage of the commercial equipment and devices that become available for use in the 26 GHz band during 2019.

[19] Telstra Submission to ACMA FYSO18-22, section 2.1, page 9. https://www.acma.gov.au/-/media/Spectrum-Review-Implementation-Taskforce/Issue-for-comment/IFC-12-2018/Telstra---FYSO-submission-pdf.pdf
[20] Consultation, middle of page 15.

03 Response to specific questions

This section contains our responses to the ten direct questions posed in the consultation paper.

1. Does the three-type model constitute an appropriate high-level representation of potential usage of the 26 GHz band? If not, are there any use cases that should be included, excluded or omitted?

Telstra agrees with and supports the ACMA's description of the three broad categories of use for the 26 GHz band as defined by Types 1, 2 and 3.

2. What are the implications for 26 GHz wireless broadband in Australia of the Electronic Communication Committee of CEPT (ECC) decision on emission limits to protect passive EESS?

We agree with the ACMA's observation that there are currently a number of uncertainties that will influence future deployment of services in the lower part of the 26 GHz band, and that "*While some preliminary observations are possible, further work is required to develop suitable domestic planning arrangements*…"[21]. Clearly, there are a number of uncertainties yet to be resolved including the capabilities of equipment to manage out-of-band emissions, deployment density (requested in Question 4 below) and ITU-R defined out-of-band emission limits to protect EESS. We submit that it is likely to be at least 12 months before some of these uncertainties are resolved; for example, out-of-band emission limits will only be resolved at WRC-19, which is 12 months away.

However, this current uncertainty need not further delay the reallocation of the entire band down to the lower limit of 24.25 GHz. We propose that the ACMA can proceed through the remaining reallocation stages to a price allocation for the defined regions. This can be achieved by placing the onus on spectrum licensee(s) to manage their deployment to meet the future ITU-R defined out-of-band emissions. Spectrum licensee(s) will have a range of options at their disposal, including adjusting output power levels, use of high performance filters, managing outdoor deployment density and/or greater use of indoor deployment.

Outside the defined regions, where apparatus licensing is proposed, the ACMA will need to track the licences issued in each unit area, along with the characteristics of those devices to ensure the aggregate noise from all Type 2 devices remains below ITU-R defined out-of-band emission limits in the 23.6-24.0 GHz band.

3. Are the proposed defined geographic areas for wide-area licensing appropriate?

We support the ACMA's decision to create at least sixteen defined regions for the 26 GHz band, as contemplated in the consultation paper. We also broadly support (subject to fine tuning) the proposed boundaries for these sixteen defined regions, which according to appendix 2 align with those for the 3.4 GHz band as detailed in Schedule 1 of the Radiocommunications (Spectrum Re-allocation) Declaration 2000[22], with the inclusion of Darwin.

In addition to the sixteen regions the ACMA has defined, we propose that a further eight regional major centres with population exceeding 50,000 people are added (representing approximately 80% of the national population). As we explained earlier, we believe that all regional towns, regardless of population, will benefit from 5G services. We submit that increasing the number of defined regions to include all population centres over 50,000 people can be done without diminishing the utility of the band for other types of services, as fixed wire alternatives will abrogate the need for fixed wireless solutions to serve those communities.

[21] Consultation, page 33.
[22] http://auction.acma.gov.au/auction_results/3.4ghz_results_page/34_pdf/aip_pdf/re-allocation.pdf

The regional centres we recommend adding are: Mackay, Bunbury, Coffs Harbour, Bundaberg, Wagga, Hervey Bay, Mildura and Shepparton. Appendix 1 contains a table with the 31 Australian cities/towns exceeding 50,000 people in 2017.

4. What is the expected proliferation of—or demand for—services deployed under type 2 (apparatus-licensed) and/or 3 (class-licensed) models?

Our answer to this question refers to scenarios inside the defined regions; we do not offer a view for locations outside the defined regions.

Inside the defined regions, we are not aware of any demand for either Type 2 (apparatus-licensed) or Type 3 (class-licensed) services. However, if there is a latent demand that we are unaware of, our proposal to modify Option 2d by setting the lower band edge to 24.7 GHz potentially solves this problem, as it reserves an allocation of 450 MHz that could be used for Type 2 or Type 3 services.

5. Comment is sought on preferred option(s) for configuring and licensing the 26 GHz band.

A variation of Option 2d, with two amendments should be implemented. The first is to set the lower band edge to 24.7 GHz to accommodate GSA determined out-of-band emission levels, and the second is to introduce a further eight regional centres so that all towns in Australia with population of approximately 50,000 or more (representing approximately 80% of the national population) are covered by a spectrum licensing arrangement.

6. If options 3 or 5 (all variants) are preferred, how much of the band should be available for spectrum licensing and apparatus licensing?

A variation of Option 2d, with two amendments should be implemented, one of which is to set the lower band edge to 24.7 GHz to accommodate GSA determined out-of-band emission levels. This modification to Option 2d effectively provides a 450 MHz segment that could be used for apparatus licensed services, in a manner that is not unlike what Options 3 and 5 are attempting to achieve. To be clear though, we are not recommending that the 450 MHz segment is rigidly allocated for apparatus licenced services, as contemplated by Options 3 or 5. Rather, we are saying that for the time being, the bottom 450 MHz should not be allocated to any specific service type (Type 1, 2 or 3), but should remain available for innovative services that may emerge in the future, using the most appropriate licensing mechanism (spectrum, apparatus or class), and subject to those services not causing interference to EESS.

7. If options 4 or 5 (all variants) are preferred, how much of the band should be available for class licensing?

A variation of Option 2d should be implemented. We do not support Options 4 or 5 (class-licensing underlay), including permutations on the option, such as limiting class licensed device use to indoor only to avoid interference. We note that network operators deploying future 5G services in mmWave bands are likely to require the deployment of indoor 5G network devices due to the poor ability of this band to penetrate buildings and other structures. As we note in section 2.5, a co-channel class licence arrangement diminishes the property rights of the spectrum licensee by introducing high levels of uncertainty, and we strongly recommend against options that introduce an underlay of co-channel class licensed devices. Our proposal to lift the lower band edge to 24.7 GHz does set aside 450 MHz (24.25-24.70 GHz) that could include class licensed devices, which we also discuss in section 2.5.

8. If options 4 or 5 (all variants) are preferred, what conditions should be applied to a class licence to protect co-frequency spectrum-licensed operations (in defined areas)? Would it be appropriate to define a means of making class-licensed use visible (for example, through a form of voluntary device registration)?

See our answer to question 7.

9. Are there any other replanning options that should be considered?

We have no further replanning options to propose at this stage.

10. Is there likely to be sufficient demand for type 1 services in regional centres outside metropolitan areas, and if so, what centres (either explicitly listed or by population threshold) should be included in the expanded licence areas?

We believe there will be sufficient demand for Type 1 services in many, if not all, regional centres and towns. However, for smaller population towns and centres, we recognise that those towns may be best served by a mix of 5G mobile services and fixed wireless services and the intensity of use of 5G may not be sufficient to justify spectrum licensing. As such, we agree with the ACMA's position that apparatus licensing is the appropriate model for geographic locations outside the defined regions, however we suggest that the number of defined regions should be increased to capture all population centres over 50,000 people.

Appendix 1: Australian cities with populations over 50,000

The table below contains a list of Australian cities where the population exceeded 50,000 in 2017[23]. The final column of the table indicates whether the cities is covered by one of the sixteen defined regions for the 26 GHz band. We recommend adding the eight towns where the population exceeds 50,000 to the list of defined geographies for the 26 GHz band.

Rank	City	2017 Pop	Included?
1	Sydney	4,741,874	Yes
2	Melbourne	4,677,157	Yes
3	Brisbane	2,326,656	Yes
4	Perth	2,004,696	Yes
5	Adelaide	1,315,346	Yes
6	Gold Coast – Tweed Heads	663,321	Yes
7	Newcastle – Maitland	481,183	Yes
8	Canberra – Queanbeyan	447,457	Yes
9	Central Coast	329,437	Yes
10	Sunshine Coast	325,399	Yes
11	Wollongong	299,203	Yes
12	Geelong	260,138	Yes
13	Hobart	208,324	Yes
14	Townsville	180,346	Yes
15	Cairns	151,925	Yes
16	Toowoomba	135,631	Yes
17	Darwin	132,708	Yes
18	Ballarat	103,481	Yes
19	Bendigo	97,096	Yes
20	Albury – Wodonga	91,923	Yes
21	Launceston	86,788	Yes
22	Mackay	80,427	No
23	Rockhampton	78,871	Yes
24	Bunbury	74,478	No
25	Coffs Harbour	70,857	No
26	Bundaberg	70,578	No
27	Melton	65,423	Yes
28	Wagga Wagga	56,181	No
29	Hervey Bay	53,492	No
30	Mildura	51,473	No
31	Shepparton	51,142	No

[23] The 50 largest cities and towns in Australia by population | 2018 update. https://blog.id.com.au/2018/population/population-trends/the-50-largest-cities-and-towns-in-australia-by-population-2018-update/