The future use of the 1.5 GHz and 3.6 GHz Bands

Submission to the Australian Communications and Media Authority

9 December 2016
Vodafone Hutchison Australia Pty Limited (VHA) welcomes the Australian Communications and Media Authority’s (ACMA) discussion paper on the future use of the 1.5GHz and 3.6GHz bands internationally and in Australia.

The ACMA has invited comments on the preliminary assessment of the highest value use of the 1427–1518 MHz (1.5 GHz band) and 3575–3700 MHz (3.6 GHz band) bands, and potential future use for MBB services. The main intention is to determine whether consideration of the 1.5 GHz and 3.6 GHz bands should be progressed from initial investigation to the preliminary re-planning stage of the ACMA’s process for consideration of additional spectrum for MBB services.

Comments on the proposal are sought on four specific issues:

1. Process for consideration;
2. International arrangements and Australian context on 1.5GHz and 3.6GHz;
3. 1.5 GHz and 3.6GHz uses for MBB services;
4. Highest value use of 1.5GHz and 3.6GHz bands;

The typical industry growth rates for MBB traffic in Australia are typically in a range of 40% to 70% per year. These growth rates have been driven by a combination of the excellent data performance capabilities of 4G, the proliferation of smart phones and strong competition in the metropolitan mobile services market. It is expected that this trend will continue until the onset of 5G wherein a greater range of services made possible by that technology, combined with a significant leap in data performance, could drive growth rates toward the higher value of the range, or possibly even greater.

The anticipated high MBB data growth rates present a formidable challenge. To maintain user data performance a commensurate increase in network capacity must accompany the growth. Furthermore, user expectations of data performance will continue to increase so it is insufficient to merely match the volumetric aspect of demand growth, network capacity growth rates must exceed the volume growth rates. The ITU-R vision for 5G MBB data rates is an expression of this growing user expectation.

In general, the required capacity increase can be met by a combination of the following instruments:

1. Increased spectrum volume.
2. Increased spectral efficiency of cellular technology as either improved 4G and/or the introduction of 5G, and where applicable combined with refarming spectrum holdings from 2G and 3G.
3. Increased site density as either macro and/or small cells.

VHA is of the view that a combination of all three of these instruments are required to keep up with demand growth. Each of the instruments has a mix of strengths and weaknesses. Two of the elements will contribute a greater amount of the required capacity—increased spectrum volume and increased spectral efficiency. The third item has a more limited potential due to the diminishing return in Australia for site density.
The magnitude of the need for much greater capacity can be illustrated in the diagram below which shows the effect of data throughput growing at between 40% and 70% annually from the end of 2016. It can be seen that an implied additional capacity of at least 5.4 times the current network capacity will be needed by the end of 2021. In fact for the higher CAGR the required capacity exceeds a factor of 14 times and both of these capacity growth factors neglect the impact of increasing user expectation which as mentioned above will raise capacity growth requirements even higher. This clearly shows the formidable challenge that not only calls for improved technology and increased site density, but also higher spectrum volume via refarming and acquisition.

Returning to the three instruments of capacity improvement, VHA sees least potential in gains that can be realised from increased site density, although this enhancement will still contribute. The reason for this is grounded in the observed prominence of data growth in suburban areas, a location where, firstly, small cells have limited utility, and secondly, macro sites are becoming more expensive and the available scope for increased density is very mild at best. Although growth in urban and CBD areas is equally strong and can be partially met by small cell deployment, these areas represent a smaller proportion of the total MBB traffic in Australia. Macro site growth, which has broader morphological applicability, is circumscribed due to site acquisition constraints combined with diminishing returns as a capacity improvement mechanism. Small cells are only applicable to very specific places with extremely high user geographic density. VHA therefore believes that most of the targeted gain needs to be from a combination of increasing spectrum volume and spectral efficiency.

The instruments of spectrum volume and spectral efficiency are linked. VHA expects that the spectral efficiency of different spectrum bands will begin to diverge strongly in favour of those higher in frequency. This is because at higher frequencies the wavelength is short enough to lend itself to practicable radio platforms for what are probably the two most powerful features that will soon emerge – beam-forming (which will re-emerge as a full 3D capability) and massive MIMO (mMIMO), the latter in different forms but most notably as Multi-User MIMO (Mu-MIMO). These features are expected to offer significant
improvement to 4G in both a Frequency Division Duplex (FDD) and a Time Division Duplex (TDD) framework, but even more so for 5G in a TDD or Full Duplex framework. When the resulting spectral efficiency is combined with the inevitably higher spectrum volume available at higher frequencies, a drastic increase in capacity can be realised and this is a fundamental component of the capacity gain that operators will be targeting to meet MBB growth trends.

Although a significant and growing disparity in capacity is expected between lower and higher frequency bands, this does not imply that the highest possible frequency bands are the most appropriate for future MBB. This is because the other important aspect for effective impact upon data trends is the inherent coverage of the band in question. Given the high prominence of suburban morphologies in MBB data trends, macro sites will continue to play the key role in network capacity and their inherent density limitations call for the use of frequency bands that can reach the most possible number of users (after incorporating emerging technological features such as beam-forming and mMIMO (band coverage)). This implies a need to focus on longer wavelength bands.

The requirements of capacity (shortest possible wavelength) and best coverage (longest possible wavelength) are therefore in tension, and in principle the wavelength must be short enough to allow the use of beam-forming and mMIMO but long enough to reach most users from macro sites. In VHA’s studies undertaken with industry partners, the range of bands between 3GHz and 6GHz represent the best compromise. Below this range, whilst still serving a valuable purpose, the frequency is too low to support the key future features in both networks and devices. Above this frequency range they become progressively more suited only to short range scenarios like those that could be served by small cells or smaller “street furniture” macro sites.

As stated above, a band’s suitability is strongly governed by practical factors that limit their deployment or practical realisation in a network and/or user device product. A key challenge that will undermine the effectiveness with which future 4G and 5G technology can be deployed is the growing number of bands to cope with in site design and construction. The introduction of 5G implies that at least one more band will be introduced on macro sites and the introduction of 1.5GHz would imply a second one although for 4G. Because sites are usually constrained in terms of a combination of available space, structural loading limits, and cost, the “best use of real-estate” principle calls for each added band to carry its own weight and well justify both the cost of the spectrum used and the very high associated deployment cost. Considering this space-cost constrained principle, then the most effective bands to consider are ones that have the optimum combination of:

- 5G support, being the highest capacity future option,
- key features that will most enhance spectral efficiency to be deployed (as discussed above),
- the most spectrum bandwidth as a volume (as discussed above), and
- well supported (or will be) in network and device roadmaps.
Due to the limitations of practical sites, adding future bands cannot in general be realised without consequences - specifically circumscribing the achievable capacity increase by limiting radio-antenna system sophistication and/or by sacrificing exiting bands to accommodate the new band. Both of these pressures often undermine the intended addition of capacity and therefore it is fundamentally important that any proposed new band be of extremely high value in capacity terms to warrant potential compromises and the high cost of deployment.

Regardless of the framework it is introduced in, the 1.5GHz band offers a lower spectrum bandwidth than other future proposed spectrum above 1GHz, has lower projected roadmap support in vendor roadmaps, has considerably lesser ability to support key future features, and in addition has not been explicitly nominated as an early 5G band. Therefore, there is no strong driver to steer MBB traffic to this band. In view of the very high traffic growth forecasts for MBB and considering the technical factors discussed, VHA believes that the 3.6GHz spectrum band has significantly greater benefit in Australia than the 1.5GHz band, and therefore, in principle the 3.6GHz band should receive a higher priority for re-planning. The 3.6GHz band satisfies the criteria described above and it is anticipated that much lesser capacity gains would be realised from 1.5GHz at a potentially higher site impact cost.

Furthermore, while the 1.5GHz band will offer some 4G capacity, it has relatively high site impact versus its low to moderate capacity potential. Notwithstanding the capacity advantages of 3.6GHz, if the 1.5GHz band can also be subject to re-planning without compromising allocation or access of the 3.6GHz band, then VHA recommends that re-planning be undertaken concurrently to expedite an increased supply of 4G spectrum which will continue to be in demand for many years.

A significant advantage of the 3.6GHz band is its adjacency to the 3.5GHz band and thus a single radio-antenna system product could likely be applied to either or to the combination. VHA anticipates that vendor network products for both bands will be readily available (and probably the same) provided that the 3.6GHz band progresses further down the path of global harmonisation and network and device ecosystem development. The TDD B42 (3.5GHz) spectrum has been generally sighted as the primary band for 5G launch circa 2020, and this is again consistent with VHA’s view that bands in this range should be the initial focus for 5G as they represent a good compromise between coverage and capacity. Presently the two bands however differ somewhat in terms of their global recognition, with 3.5GHz already being well recognised and as described in the ACMA’s consultation paper, 3.6GHz being less so but with continuing interest including in Region 3.

The adjacency of the 3.6GHz and 3.5GHz bands is significant not simply because of consolidated network equipment aspects but most importantly because there is, in VHA’s view, otherwise insufficient spectrum in Australia in the 3-6GHz range to form a foundation for 5G. Based upon typical traffic forecasts and advanced modelling with industry partners VHA has determined that at least 300MHz of unpaired spectrum in the 3-6GHz range (inclusive of current MBB allocations) needs to be made available for MBB in Australia in the coming years. This collective requirement implies the need to allocate 3575-3700MHz with urgency and naturally in conjunction with the companion spectrum in the 3400-3575MHz range,
even if urgency results in staggered access to the respective bands. The connection between these two bands and the need for a well-orchestrated and consistent allocation framework cannot be understated.

In order to best serve future applications and MBB user experience it is necessary to be able to use much larger bandwidths than is allocated in today’s UHF centric spectrum holdings (which are usually 2x10 – 2x30MHz with a maximum 2x20MHz RF carrier bandwidth). The RF carrier bandwidth for 5G should be much closer to an unpaired 100MHz. It is noteworthy that allocating other 3-6GHz spectrum (e.g. circa 4.5GHz) not identified in the ACMA consultation and that is not adjacent to the 3.5GHz band will result in very inefficient spectrum usage because once allocated across multiple industry players as the carrier sizes will become too small, i.e. they will not be “5G size”. The implication would be that other supplementary spectrum in the 3-6GHz range would have to be acquired to compensate, which will exacerbate the proliferation of bands on site.

The 3.6GHz band has high priority for Australia and must be considered in conjunction with 3.5GHz in order not to undermine the fundamental intent of capacity and highest value use. A clear corollary is that any relatively low economic value incumbent usage such as those mentioned in the ACMA paper and notably also the NBN fixed wireless links need to be moved out of the collective 3400-3700MHz spectrum band in order to meet Australia’s MBB objectives. Given the currently lesser recognition of 3.6GHz and inevitable forthcoming need to make available large capacity and for 5G, this relative priority in VHA’s view even extends to increasing the available spectrum for allocation in 3.5GHz at the expense of that available in 3.6GHz if that trade-off is unavoidable.

Conclusion

VHA is of the view that the rapidly growing MBB traffic characteristics in Australia call for maximising spectrum release through an expansive allocation of available spectrum. That said, some bands are inevitable more valuable than others for the purpose of delivering the much sought after capacity and data performance and doing so affordably due to their international harmonisation and expected commercial adoption. Considering important technical, practical, financial, and economic factors, MBB services in the early 5G era will call for at least a contiguous 300MHz to be made available for industry in the 3-6GHz frequency range. The 3.6GHz should therefore be progressed from the initial investigation stage to the preliminary re-planning stage in the ACMA’s process for consideration of additional spectrum for MBB services.

Given the limited supply available in the 3.5GHz band, the 3.6GHz band represents an invaluable complement resource subject to positive future outcomes for network/device equipment eco-system alignment. The 3.6GHz band should be allocated in conjunction with the 3.5GHz band as the priority for initial 5G services in Australia, although staggered allocation can be considered in favour of earlier access.

Continued forecast growth in 4G MBB traffic calls for well harmonised 4G spectrum to be allocated. VHA recommends that the 1.5GHz spectrum therefore should also be considered to progress from the initial investigation stage to the preliminary re-planning stage subject to the strong caveat that the utility of this spectrum from 2020 onwards will be substantially less than that of 3.5GHz and 3.6GHz bands. Therefore,
1.5GHz should only be considered at this stage as long as the re-planning or allocation of 3.5GHz and 3.6GHz are not delayed by so doing.

In summary every possible effort should be expended to make available the maximum possible spectrum volume in the order of:

1st priority for allocated spectrum volume and access timing – 3.5GHz for MBB anticipating the use of 5G technology.

2nd priority for allocated spectrum volume and access timing – 3.6GHz for MBB anticipating the use of 5G technology.

3rd priority - allocation and access to 1.5GHz and maximise available volume and utility for MBB using FDD 4G technology.
In relation to the issues for comment summarised on pages 7-9 of the ACMA paper VHA provides the following feedback in view of its position discussed above.

1. Should the 1.5 GHz band and/or the 3.6 GHz band be progressed from the initial investigation stage to the preliminary re-planning stage in the ACMA’s process for consideration of additional spectrum for MBB services? Why/Why not?

   **VHA** – yes as a movement toward allocation of more 4G and initial 5G spectrum respectively.

2. Should either of the 1.5 GHz and 3.6 GHz bands be prioritised through the ACMA’s process for consideration of additional spectrum for MBB services? If so, which band? Why?

   **VHA** – yes, the 3.6GHz band should be prioritised because of its better fit for forthcoming technology requirements (3D beam-forming and mMIMO), and far higher capacity delivered per unit of site space and implementation cost. However, this should be done collectively with the 3.5GHz band as a framework even if access dates necessarily differ.

3. Are there specific issues, other than those mentioned, that may affect the timeframe in which the 1.5 GHz or 3.6 GHz bands could be made available for MBB?

   **VHA** – No, at this time VHA does not foresee any issues other than those outlined by the ACMA that may affect the timeframe in which the 1.5 GHz or 3.6 GHz bands could be made available for MBB.

4. If the 1.5 GHz and 3.6 GHz bands are re-farmed for MBB, would there be benefit in allocating the bands simultaneously?

   **VHA** – There is no explicit benefit other than the fact that 4G and 5G traffic levels will both grow for some years and a capacity resource is sought for both of them.
Questions specific to the 1.5 GHz band:

5. The ACMA seeks comment on expected future use of the 1.5 GHz band by the fixed, broadcasting and broadcasting-satellite services and by the Department of Defence in Australia.

   VHA – Because this spectrum is not mission critical for MBB in Australia there is no extreme concern, however the principle of making the most geographically available allocations possible for MBB will always significantly increase the utility and value of the spectrum in higher usage areas, particularly metropolitan zones.

6. Comment is sought on the potential deletion or modification of footnote AUS3 from the Australian Radiofrequency Spectrum Plan (ARSP).

   VHA – For the same reason as stated in response to Question 5, giving priority to MBB is recommended although it implies that a secondary aeronautical mobile service would become highly restricted.

7. If the 1.5 GHz band is re-farmed for MBB services, what frequency arrangement should be adopted? Should a frequency division duplex (FDD), supplemental downlink (SDL) or time division duplex (TDD) arrangement be adopted? Why/why not? What type of arrangement should be adopted (that is, 3GPP bands 11 and/or 21, 3GPP band 32, 3GPP band 45 or another arrangement)?

   VHA - Mobile operator traffic is usually heavily weighted on the downlink as circa 90% or more as a proportion of the total traffic on both links (aside of special events). Hence, given that the purpose of the band is envisaged as capacity as opposed to coverage the structure should be governed by the highest value use of downlink. As such it is recommended that the arrangement be FDD or SDL as they have similarly proposed downlink allocations sizes. Considering the eco-system incentives, the SDL arrangement is preferred.

8. If the 1.5 GHz band is re-farmed for MBB services, what geographical areas should be re-farmed? To what extent are mobile network operators (MNOs) interested in the 1.5 GHz band outside of metropolitan areas?

   VHA - Metropolitan areas generally carry the highest traffic levels and more 4G spectrum would be beneficial. The outcomes of the regional 1800 auction also suggest a short supply of contiguous regional spectrum in Australia with efficient carrier bandwidth (ideally 20MHz) and thus regional areas could also benefit.

9. If the 1.5 GHz band is re-farmed for MBB services, should a geographically and/or spectrally staged process be considered, where more heavily utilised parts/areas are re-farmed later than those that are more lightly utilised?

   VHA – Spectrally staged poses a risk that the allocations may end up fragmented which will neutralise the spectrum value. Spectrally staged allocation should only be considered if the entire release timeframe is clear from the outset and operators can acquire “part thereof” as a temporary step. Staged geographic release is acceptable provided again that the full eventual allocation is clear at the outset.

10. What are the alternative spectrum or delivery options for current users of the 1.5 GHz band if the band is re-farmed for MBB services and migration of incumbent services is required?

    VHA – VHA cannot comment on this.

11. Could services, in particular fixed services, provided in the 1.5 GHz band be migrated to new or existing mobile networks in areas where the band is re-farmed for MBB services?

    VHA – VHA cannot comment on this.
12. Should existing users (some or all) be allowed to continue operation within the band either temporarily or on an ongoing basis?

VHA – The same considerations as for Question 5 apply. Temporary continuance as a means of expediting general availability is prudent provided that the utility in the long term is not undermined by resulting fragmentation in the allocation process.

13. What types of sharing arrangements could be put in place to facilitate coexistence between MBB services and existing users of the 1.5 GHz band in both the short and long term?

VHA – Existing services that cannot vacate the band at the outset should be re-planned to occupy one end of the band in the most spectrally concentrated manner possible so that for MBB the maximum possible RF carrier size can be exploited in the affected areas. The designated end of the band should be the one that, if applicable, is least compatible with FDD 4G operation in terms of adjacent channel impacts.

14. Comment is sought on the ACMA’s proposal to progress the 1.5 GHz band to the preliminary re-planning stage of its process for consideration of additional spectrum for MBB services, as detailed in the ACMA’s mobile broadband strategy.

VHA – As discussed in our introduction, VHA sees this as the 3rd priority but supports it in principle. It should not enter preliminary re-planning if any delay results to allocation or access of the 3.5GHz or 3.6GHz bands.

15. To assist the ACMA in conducting a comprehensive assessment of the highest-value use for the 1.5 GHz band, responses to the following questions are requested:

a. Do you see demand for fixed broadband/MBB services in the 1.5 GHz band?

VHA – There will be a growing demand for 4G MBB services in Australia up to and somewhat beyond 2020. The 1.5GHz band has some commendable characteristics however it is not as effective as the 3.5GHz and 3.6GHz bands. Nonetheless, there will be some demand for the band.

b. What benefits do you envision from using the band for fixed broadband/MBB services?

VHA – Primarily increased downlink capacity. There is another benefit too, the reasonable coverage characteristics of 1.5GHz band (compared to 1.8GHz or higher) can relieve some traffic load from sub-1GHz bands. The proportion of mobile traffic that can be captured by bands with 1.8GHz and higher is generally insufficient resulting in premature congestion in low bands (which carry the difference) as opposed to high bands – resulting in lower user experience at locations further way from cell sites. Therefore the 1.5GHz band having a few decibels better coverage than 1.8GHz and above could be a helpful way to offload low bands.

c. What are relevant data points (for example, market based allocation results) for considering the demand for 1.5 GHz band spectrum for use by MBB providers?

VHA – The 1.5GHz band has already been allocated in several European markets including Germany and the United Kingdom. As both are major mobiles market, the publically available information on these allocation processes and secondary market trades may provide the ACMA with some insight into the demand for these bands from the mobile industry.

d. Is demand the same or similar across regions (that is, across metropolitan, rural and remote areas), or are some regions more likely to be in demand for MBB providers?

VHA – same response as for Question 8.

e. Do incumbent 1.5 GHz band licensees require ongoing access to the band, or are there plans to cease operation at some future point?

VHA – VHA cannot comment on this.
f. Do other options exist for the delivery of point-to-point, point-to-multipoint, fixed receive, aeronautical and radiodetermination incumbent services? How practical are they? What are the costs involved? Will there be a diminution of the service delivered if MBB services are introduced in the band?

VHA – VHA cannot comment on the alternatives or costs however alternatives should be considered.
Questions specific to the 3.6 GHz band:

16. The ACMA seeks comment on expected future use of the 3.6 GHz band by fixed, fixed-satellite, amateur and radiolocation services in Australia.

**VHA** - The 3.6GHz band is a critical MBB resource for the 5G era and all of it needs to be allocated for this purpose. The ACMA should expedite re-planning for this band.

17. If the 3.6 GHz band is re-farmed for MBB services:
   a. Do you agree that a time division duplex (TDD) arrangement should be adopted? Why/Why not?
      **VHA's** - It should be an unpaired spectrum which is notionally the framework for 5G and will be used either for TDD or Full Division Duplex operation (both of which will be used as unpaired spectrum).
   b. Should all or only part of the band be considered for re-farming?
      **VHA's** – all of it, consistent with a goal of making 300MHz+ of spectrum available for the mobile industry.
   c. Should different amounts of spectrum be re-farmed in different areas?
      **VHA's** – Not in principle, generally all of it should be re-farmed for a consistently available amount of spectrum.

18. If the 3.6 GHz band is re-farmed for MBB services, what geographical areas should be considered?

**VHA’s** – the 3.6GHz band should be re-farmed to enable MBB across all geographic areas.

19. If the 3.6 GHz band is re-farmed for MBB services, should existing users (some or all) be allowed to continue operation within the band, either temporarily or on an ongoing basis? Should/could sharing arrangements be developed? Should sharing only be considered for some services or specific licences? If yes, what kind of arrangements would be suitable to support the ongoing operation of incumbent services or specific licences? If no, why?

**VHA’s** – given the high priority for capacity and 5G, very limited existing use and sharing should be allowed, this is only a concession if otherwise the access will be later than the onset of 5G circa early 2020. The objective should be to free up the whole 3.6GHz band as soon as possible. Where incumbent services are proposed to continue on a temporary basis, they should only be services with a very limited geographic footprint so that exclusion zones are greatly minimised. Any remaining incumbent services will soon undermine the objectives of a mobile broadband service and potentially a fixed broadband service and thus a plan should be developed to remove these services as soon as possible. In the interim if sharing is required, the ACMA should what exclusion zones would apply.

20. If the 3.6 GHz band is re-farmed for MBB services, and migration of incumbent services is required, are there alternative spectrum or delivery options?

**VHA’s** – Based upon VHA’s recommendation this question is pertinent for the entire 3400-3700MHz range. Incumbent services should be ideally moved away from any proposed 5G band and thus notionally above 6GHz. As a second preference above 3700MHz will still allow the 100MHz contiguous allocation discussed to be realised. Specifically for the NBN fixed wireless access services, fibre and satellite alternatives need to be revisited in light of the economic value being forfeited by retaining such services in the 3400-3700MHz range when mobile broadband is the highest value use of the spectrum. (Naturally, to the extent the spectrum has ongoing value for fixed wireless services, the NBN and other fixed wireless providers should not be precluded from participating in an allocation process).
21. In determining whether to re-farm the 3.6 GHz band for MBB, are there any adjacent band issues that should be considered? This includes:
   a. the effect such use may have on adjacent band services
   b. the effect adjacent band services may have on the utility of the 3.6 GHz band for MBB services.

   **VHA’s** – Given the high economic value of MBB services priority should be granted to them and therefore re-planning of adjacent band services should be considered as a natural extension to re-planning incumbent in-band services. The utility of the entire 3400-3700MHz needs to be strongly facilitated and guarded to ensure that the requisite industry capacity objectives are met.

22. If the 3.6 GHz band is re-farmed for MBB services, should the ACMA review arrangements in the broader 3400–3700 MHz band? Why/Why not?

   **VHA’s** – Yes, for the reasons discussed in main response. The entire 3400-3700MHz band needs to be considered as the primary 5G resource and planned accordingly to maximise the size and contiguous nature of future holdings. It should be reorganised so that existing holdings (eg those of Optus) are contiguous and thus optimum use can be made of the resource and the highest value use can be attained by allowing future licensees to establish a contiguous allocation as large as possible.

23. Would such a review be facilitated through the alignment of geographical boundaries in the 3.6 GHz band with existing boundaries defined for spectrum and apparatus licensing in the 3400–3575 MHz band (that is, to facilitate trading)?

   **VHA’s** – Yes but for another more important reason too - because a target of circa 100MHz contiguous allocations should be facilitated for the 3400-3700MHz range and thus it should have a unilateral framework for geographic allocation, core conditions, and ideally timing if that is possible.

24. Is there anything else that could be considered as part of the 3.6 GHz band process that may facilitate a future review of the broader 3400–3700 MHz frequency range?

   **VHA’s** – We strongly recommend the ACMA and/or Australian Government engaged in an independent and transparent assessment of the highest economic and social value from the use of the 3400-3700MHz band across the range of potential views. We are confident that any genuinely independent assessment will determine that competitive 5G investments are essential to enhancing Australia’s prosperity and far superior to any other alternative use of the spectrum. The ACMA should commission this assessment immediately and it should be undertaken in a manner that does not delay the allocation of spectrum in the 3400-3700MHz frequency range.

25. Comment is sought on the ACMA’s proposal to progress the 3.6 GHz band to the preliminary re-planning stage of its process for consideration of additional spectrum for MBB services, as detailed in the ACMA’s mobile broadband strategy.

   **VHA’s** – A clear mandate exists for re-planning this spectrum as discussed in the body of our response.

26. To assist the ACMA in conducting a comprehensive assessment of the highest-value use for the 3.6 GHz band, responses to the following questions are requested:
   a. Do you see increasing demand for fixed broadband/MBB services in the 3.6 GHz band? What benefits do you envision from using the band for fixed broadband/MBB services?

      **VHA** – Yes, as stated in the introduction, this band is a natural extension to the 3.5GHz band although admittedly with a lesser state of harmonisation, so in conjunction with the 3.5GHz band it has high likelihood of underpinning 5G carried services in Australia. The benefits already stated are its technical and practical suitability that will result in very high capacity and hence user experience benefits, notably supporting beam-forming and mMIMO and with usable coverage for a wide range of applications. The
benefits will therefore be substantial user data speed and network capacity to support a high number of users with and with greater data performance.

b. Which regions of Australia will be in demand for fixed broadband/MBB services in the 3.6 GHz band?
   VHA – The spectrum should be made available across all parts of Australia.

c. Is demand the same or similar across regions, or are some regions/areas more likely to be in demand for MBB providers?
   VHA – as response as for Question 26.b.

d. Do incumbent 3.6 GHz band licensees require ongoing access to the band, or are there plans to cease operation at some future point?
   VHA – VHA cannot comment on this but notes the relevant consideration for the ACMA is to determine what constitutes the highest value use.

e. Do other options exist for the delivery of fixed, fixed-satellite and amateur incumbent service, how practical are they? What are the costs involved? Will there be a diminution of the service delivered if MBB services are introduced in the band?
   VHA – VHA cannot comment on the costs however alternatives should be considered in accordance to our response to Question 20.

f. Should further consideration be given to the migration of incumbent 3.6 GHz band FSS earth stations to low density population areas?
   VHA – Yes, although VHA cannot comment on the feasibility.