



Wireless broadband in the 26 GHz band options paper

VODAFONE SUBMISSION

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Executive summary

Vodafone Hutchison Australia Pty Limited welcomes the opportunity to comment on the Australian Communications and Media Authority's (ACMA) Options Paper, Wireless Broadband in the 26GHz band.

The 26 GHz band is an important input for the 5G ecosystem. It is one of the first internationally harmonised millimetre wave (mmWave) bands and has garnered significant international support ahead of the World Radio Conference 2019 (WRC19). The 26 GHz band will be used to provide additional capacity for 5G networks for mobile broadband networks albeit over a shorter range than the 3.5 and 3.6 GHz bands.

The movement into the mmWave bands heralds a new era for the mobile industry. Commercial equipment operating in the mmWave bands will support bandwidths of up to 1 GHz, marking a step change in the capacity and capability of mobile networks. These benefits are, however, offset by the propagation characteristics of the mmWave bands. The limited range of the mmWave frequencies will require mobile network operators (MNOs) to consider different network topologies to unleash the capacity enabled by the higher bandwidths.

The investment required to utilise the 26 GHz band will be significant given its importance to the 5G ecosystem. It will include the densification of existing wireless broadband networks, the deployment of ultra-high capacity / ultra-low latency solutions at specific locations and the proliferation of devices reliant on the network for continuous, real-time machine-to-machine communications.

The mobile broadband industry has proven to be the highest value use for spectrum in all recent instances where an internationally harmonised spectrum band is under consideration by the ACMA. The public benefits from investment in mobile broadband capacity are well-established and will increase with the deployment of 5G technologies. For instance, Deloitte Access Economics indicated that 5G will add to the \$34 billion in long-term productivity benefits from mobile technology estimated for 4G networks in 2015.

International arrangements strongly support Australia adopting an allocation of 24.25-27.5 GHz, with the 26.5-27.5 GHz range prioritised for clearance as it is consistent with the approach taken in Europe and partially overlaps the approach taken in South Korea. Vodafone supports extending the allocation of spectrum down to 24.25 GHz on a 'buyer beware' basis (this would create two classes of spectrum in the 26 GHz band) provided that this does not impede efforts to ensure there is a least 1 GHz of 'clear' spectrum in the 26.5-27.5 GHz frequency range.

As an alternative but less preferred option, the ACMA may wish to consider a phased release of the 26GHz band, with the lower part of the band forming part of a later allocation of spectrum that comes after the priority release of at least the 26.5-27.5 GHz range. Vodafone understands that there are limited difficulties with extending the priority release to 24.7 GHz as a lower bound. If the ACMA were minded to take a phased release, Vodafone would support the 24.7-27.5 GHz range being allocated first, with the lower part of the range being made available on a 'buyer beware' basis. The 24.24-24.7 GHz range could follow in a phase II allocation process.



The mobile broadband industry's past approach to spectrum management supports an ACMA to pursue spectrum licensing in metro and major regional centres (option 2d). The industry has proven to be highly effective at putting spectrum to its highest value use through:

- deployment and upgrading of technologies that maximise spectral efficiency;
- re-farming of existing spectrum;
- deploying complementary technologies to mobile broadband (e.g., fixed wireless); and
- making spectrum available to other users where it is under-utilised.

The industry's capacity to invest and maximise the utility of its spectrum assets has been underpinned by the spectrum licensing framework. The exclusive access and long-term certainty provided by spectrum licences will be essential to unlocking the innovation potential of the 5G revolution. Other licensing options (including mixed licensing options) are likely to fetter the property rights of spectrum licences, creating the potential for unforeseen and adverse economic and technical consequences that undermine the highest value use of the spectrum. The ACMA envisages class licences would be used by type 3 users (i.e., business enterprise services operated by private entities within the confines of their own premises or land estate) however this would not prevent such licences putting that spectrum to commercial use. This seems contrary to the intent behind the ACMA's proposed approach for both type 1 and type 3 users. It is also not clear how the ACMA envisages the co-frequency approach would operate in settings where there is a high overlap between public and private users, and between indoor and outdoor environments (e.g., hospitals or universities).

Vodafone does not support an 'underlay' class licences due to the potential interference issues. Wireless broadband networks are not (and should not be) designed to circumscribe coverage at private enterprise locations - mobile users expect coverage at these locations. Moreover, the interference management overheads from co-frequency class licensing should not be underestimated. An example of such interference issues is available today where the 900 MHz licences used by mobile networks overlap the Industrial, Scientific and Medical (ISM) frequency range used in the US. US-imported devices that utilise the ISM band which have not been authorised for use in Australia can cause extensive interference issues for Australia's mobile networks. The economic costs associated with interference management are significant. Based on our experience with the 900 MHz band (and ACMA's own compliance work in this area), we do not believe there is a feasible means of implementing a co-frequency approach for spectrum and class licences particularly given the numerous interference issues that would occur in high density cities like Sydney, Melbourne and Brisbane.

Any interference would likely be exacerbated at boundaries of high foot traffic venues (e.g., hospitals, universities, and shopping centres) where mobile users are constantly moving between spectrum and class licence coverage areas. Furthermore, the dispersed and localised nature of the ACMA's envisaged type 3 users may mean there is no 'one size fits all' approach to interference management that would be acceptable to both type 1 and type 3 users. This is likely to make the management of any interference complex, costly and impractical.



It may be feasible for class licences to be issued in a small part of the 26 GHz band. Vodafone recognises the utility of creating class licences for business enterprises to create private networks. This approach to spectrum management has contributed to the success and ubiquity of WiFi networks for both public and private use. A critical precondition to the success of WiFi has been the international harmonisation of spectrum arrangements to support it. This has enabled device manufacturers to benefit from significant economies of scale in production and enabled WiFi devices to operate even as users travel with their devices around the world. If these benefits of WiFi are to be replicated with the 26 GHz band, it is imperative that it is based on a common international standard. The ACMA should assess international developments on the standardisation of frequency ranges for use by low powered devices on private networks prior to making a domestic decision on class licensing in the 26 GHz band. Such an approach should only be adopted in a small part of the 26 GHz band, and this must be outside the 24.7-27.5 GHz range.

The ACMA should not underestimate the potential inertia of type 3 users moving to private 5G networks if they have existing WiFi or private LTE networks. The ACMA ought to investigate this issue prior to making a decision on class licences in the 26GHz band as this will significantly impact the economic benefits associated with any class licensing arrangements (and may depress the economic benefits associated with any spectrum licences issued in the 26GHz band, preventing the spectrum from being put to the highest value use).

Lastly, Vodafone notes that consideration of the 26 GHz band ought not to occur in isolation; decisions made regarding the 26 GHz may impact other bands, and vice versa (for example outcomes of the 3.6 GHz auction would have a significant impact on the market demand for 26 GHz spectrum). The ACMA should have appropriate consideration of other relevant bands in its decision making process.

Response to ACMA questions

Potential wireless broadband deployment models

ACMA Question 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?

The three-type model potentially describes different users rather than different uses of the spectrum. As we understand the three-type model, the underlying infrastructure and technology used to deliver type 1 and type 2 services will be similar even if the business models of these users are different. Furthermore in the interests of efficiency and thus highest value use, the same licensee may wish to offer both type 1 and type 2 (and indeed, type 3 as well) services and therefore it is more efficient to obtain a collective contiguous allocation and be able to vary the proportion of the allocation between the two services as they evolve. Given this, type 1 and type 2 users should compete in an allocation process, typically an auction, for the 26 GHz spectrum licences in the geographic areas identified under option 2(d) and both be eligible in the 'first-in, best-dressed' or 'beauty contest' approaches typically used for the allocation of apparatus licences outside these locations.



The type 3 user could resemble a business enterprise that deploys a private LTE network as some mining companies do today or it could resemble the WiFi networks at many private premises. In the case of the former, such type 3 users should participate in the allocation processes for spectrum and apparatus licences. In the case of the latter, there is merit in assessing the international harmonisation of spectrum arrangements to determine if there is WiFi-like part of the 26 GHz band that will be globally adopted for 5G devices. Subject to international developments, a small part of the 26 GHz band (outside 24.7-27.5GHz range) could potentially be class licensed for 5G devices after further investigation by the ACMA into the likely adoption of such devices.

Interference management and co-existence between services

ACMA Question 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?

The ECC has a major influence on the technology implemented by network and device manufacturers. Irrespective of the merits of the ECC decision, we expect the technology roadmaps for early 5G deployment to focus on the 26.5-27.5 GHz range as a significant number of European countries focus their allocations on the upper 1 GHz portion of the 26 GHz band. The 26.5-27.5 GHz frequency also partially overlaps the frequency range of 26.5-28.9 GHz adopted by South Korea. Given the international focus, Australia's 5G roadmap will be optimised by ensuring the full maximum amount of spectrum is available in the 26.5-27.5 GHz range. As such, the 24.25-27.5 GHz options must be regarded as highly preferred to the 24.25-27 GHz options.

The ACMA should continue to pursue making the 24.25-26GHz part of the 26GHz band available for wireless broadband. Vodafone supports extending the allocation down to 24.25 GHz on a 'buyer beware' basis. This may, for instance, encourage a prospective bidder to acquire the spectrum and then work with the ACMA and international stakeholders to accelerate the standardisation and harmonisation of this band for wireless broadband use. Such an outcome would bring economic benefits to Australia by providing a strong incentive for the spectrum to be put to its highest value use while removing the uncertainty the ACMA might otherwise face from the international development of this lower part of the band.

While Vodafone supports the allocation of the entire 24.25-27.5GHz range at the same time, Vodafone does not suggest that the entire range should be treated as homogeneous spectrum. Given the very likely difference in values of 'clean' and 'buyer beware' spectrum, the ACMA should treat them as two separate products in an allocation process such as an auction. Vodafone considers that unique allocation limits should apply to each product.

As an alternative, the ACMA may wish to consider a phased release of the 26GHz band, with the 24.25-24.7GHz range forming part of a later allocation of spectrum that comes after the priority release of the 24.7-27.5 GHz range. Vodafone understands that there are a lower bound of 24.7 GHz would ensure protection of passive EESS. The lower portion of the 24.7-27.5 GHz range would be offered on a 'buyer beware' basis.



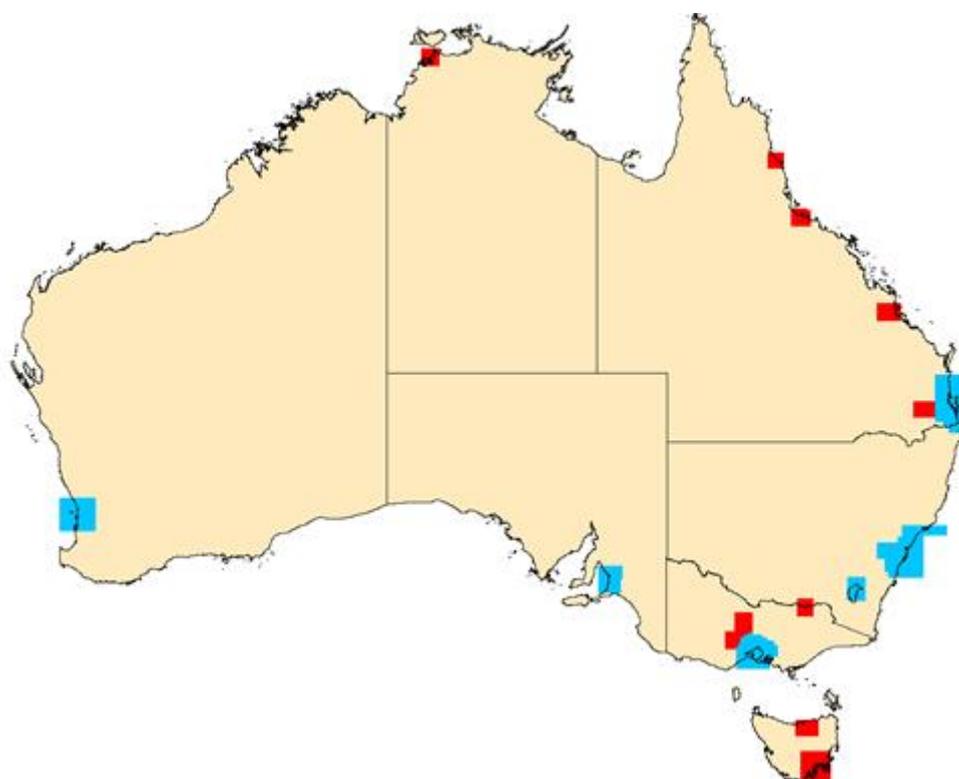
Subject to international developments, there may also be merit in allocating a relatively small part of the lowest part of the 26 GHz band as a class licence for private networks. Vodafone recognises the utility of creating class licences for business enterprises to create private networks. This approach to spectrum management has contributed to the success and ubiquity of WiFi networks for both public and private use. A critical precondition to the success of WiFi has been the international harmonisation of spectrum arrangements to support it.

26 GHz band options

Geographic areas

ACMA Question 3: Are the proposed defined geographic areas for wide-area licensing appropriate?

Vodafone supports the release of the 26 GHz band in the geographic areas defined by the ACMA. Both the metro areas (blue shading) and the regional centres (red shading) should be regarded as a high priority for release. These areas constitute the high population cities in Australia, and ensure that major regional centres are not left behind in the development of Australia's 5G ecosystem.



Vodafone notes the ACMA's assessment that there is unlikely to be a strong case for Australia-wide spectrum licensing at the present time. To the extent operators have requirements for mmWave spectrum outside the metro plus regional centre areas then this demand may be best managed through the use of apparatus licences (although the ACMA must ensure it prevents the monopolisation of spectrum in these areas).



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

Within the geographic areas defined by the ACMA, that is the metro plus regional centres, the demand for type 2 and type 3 services is likely be far less than the demand for spectrum by mobile broadband. The ACMA has identified that there are 34 million mobile services and 8 million fixed internet services nationally.¹ The vast majority of these services are in the metro plus regional centres. This suggests that there is already likely to be strong demand for 5G services as the wireless broadband industry evolves to the new technology.

Beyond mobile and fixed wireless services, the 5G ecosystem promises to herald a dramatic increase in connected devices. The Internet of Things (IoT), and the technologies it empowers such as robotics or autonomous vehicles, will increase the spectrum requirements for mobile operators over the next decade and beyond. It is this expected demand that should be given primacy by the ACMA and it will be driven by wireless operators deploying 5G technology to support massive Machine-Type Communications (mMTC) rather through the proliferation of type 2 and type 3 users.

Re-planning

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

Vodafone strongly supports option 2d, the issue of spectrum licences in the 24.25-27.5GHz range in the metro plus major regional centres. Option 2c is our second preference though we do not believe there is any compelling reason for the ACMA to exclude major regional centres from being issued with long-term 5G spectrum licences. The priority focus should be on ensuring the release of 'clean' spectrum in the 26.5-27.5 GHz range (whether or not the ACMA takes a phased approach) with spectrum in the lower part of the band released on a 'buyer beware' basis.

Vodafone does not believe there is any merit in curtailing Australia's 5G future - the ACMA's priority must be on ensuring the release of spectrum up to 27.5 GHz. Options 2a and 2b do not maximise the alignment of Australia's 26 GHz band with Europe and South Korea because they curtail upper part of the 26 GHz band at 27 GHz. The missing 500 MHz (compared to options 2c and 2d) could lead to Australia's 5G networks falling behind our international peers, with flow-on impacts to 5G dependent sectors such as remote health service delivery, robotics and autonomous vehicles. There is little prospect of a remedy in the short-medium term if an insufficient quantum of international harmonised spectrum is released in the 26 GHz band.

Vodafone does not support apparatus licensing (options 3 and 5) for the 26GHz band in the metro plus major regional centre areas. Demand for spectrum in these areas is likely to exceed supply and the ACMA

¹ p7, *Communications report 2016-17*, ACMA.



should not set aside for speculative (and potentially inefficient) spectrum use cases. The certainty provided by spectrum licences is necessary for investment and downstream commercial agreements regardless of whether the user is identified as type 1 or type 2 in the ACMA's taxonomy of uses. To the extent, there is a case for supporting assignment to type 2 users this should be managed either via their participation in a price-based allocation process or the secondary market.

Vodafone does not support the co-frequency option approach to class licences set out in option 3 however it sees some merit to further investigating options for class licensing in the lower part of the 26GHz band (see responses to questions 7 and 8 for a more detailed response).

ACMA Question 6: If options 3 or 5 (all variants[2]) are preferred, how much of the band should be available for spectrum licensing and apparatus licensing?

Vodafone does not support options 3 or 5 in the geographic areas defined by the ACMA. In the long term, no amount of spectrum should be available for apparatus licensing. In the event, the ACMA adopts a phased release of the 26 GHz band, with the 24.25-24.7 GHz range forming part of a later allocation of spectrum that comes after the priority release of the 24.7-27.5 GHz range, then apparatus licences may persist in the lower part of the band for a period of time.

However, Vodafone notes again that it is opposed to options 3 and 5. Vodafone submits that the highest value use of the 26 GHz band is to make the entire band available at the same time with the lower portion (e.g., 24.25-26.5 GHz) being allocated on a 'buyer beware' basis.

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

Subject to international developments, the ACMA could contemplate a relatively small part of the 26 GHz band as a class licence for private networks under option 4. (Vodafone does not support option 5 as set out in its response to question 5). It is premature to provide a view on how much of the band should be made available for class licensing. The ACMA should assess international developments on the standardisation and adoption of frequency ranges for private networks prior to making a domestic decision on class licensing in the 26 GHz band. The monitoring of international developments should not delay the priority release of spectrum at least in the 26.5-27.5 GHz range.

Vodafone does not support co-frequency assignments of spectrum and class licences. We have significant concerns (as set out in the Executive Summary) about the potential interference that could be caused by co-frequency assignments. Interference issues are likely to be costly to identify and remedy. Moreover, such cost are unnecessary and avoidable given the quantity of spectrum available in the 26 GHz band. If the ACMA does pursue class licensing in the 26 GHz band, the benefits associated with this use could be realised through issuing the class licences in a small portion of the lower part of the 26 GHz band.



ACMA Question 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)?

We regard the issue of co-frequency allocation as distinct and different from the issue of whether there is any merit to the ACMA pursuing class licences in part of the 26 GHz band. As set out in question 6, Vodafone does not support co-frequency assignments of spectrum and class licences in the metro plus regional centres geographic issue.

ACMA Question 9: Are there any other replanning options that should be considered?

We are not aware of any other replanning options that should be considered at the present time. If other replanning options emerge through the consultation process the ACMA should consult on those options prior to making any recommendations on them.

Assessment of options

ACMA Question 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?

Yes, based on Vodafone's experience there is likely to be demand for mmWave services in major regional centres. We consider the locations identified by the ACMA appropriate. However, if the ACMA desire an explicit population threshold for major regional centres, we suggest that all Australian cities with an estimated residential population above 85,000 people at June 2017 based on the Australian Bureau of Statistics' Regional Population Growth, 2016-17 (cat no. 3218.0) survey should be assessed for whether a suitable geographic licence area can be defined that will support a mmWave network in that city and its immediate surrounds.