**Submission to the Australian Communications and Media Authority**

**Future use of the 3.6 GHz band**

**Options paper and Highest value use assessment-Quantitative analysis**

**INTRODUCTION**

Huawei welcomes the opportunity to make this submission to the Australian Communications and Media Authority (ACMA) in response to its Future use of the 3.6 GHz band*.*

Huawei applauds the ACMA for its very comprehensive assessments on the highest value use of the 3575-3700 MHz (3.6 GHz band), and representing detailed analyses and effects to incumbents for each option as well as alternative solutions and mitigation considerations for the next steps, ensuring the future optimal use of the 3.6 GHz band in Australia.

We are well aware of and appreciate the work undertaken by the ACMA during this process and the difficulties in trying to balance the wide range of needs and requirements of the spectrum demands of sectors and industries.

Huawei supports the ACMA’s continued development policies and regulatory frameworks in facilitating industry with efficient spectrum planning for the national requirements while harmonising with international and regional directions and developments in making Australia a leader in global mobile economies.

Huawei looks forward to further engagements and collaborations with the ACMA for this important matter of spectrum management and work programs. Please do not hesitate to contact us via email at [tintin.madayag@huawei.com](mailto:tintin.madayag@huawei.com) if you have any queries to our points in this submission.

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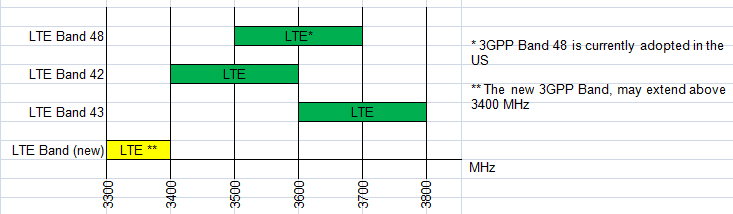
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**GENERAL INFORMATION ON FREQUENCY ARRANGEMENTS FOR 3300-4200 MHZ**

* 3GPP LTE and its evolution

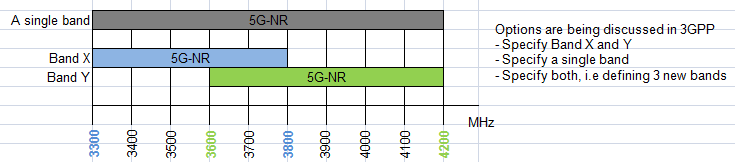
3GPP has already specified the LTE channel arrangements and the required Transmitter/Receiver characteristics for operating bands in the 3400-3800 MHz range. The industry is also currently working with 3GPP for a new LTE band in the 3300-3400 MHz with a target completion date of March 2018. (Reference: 3GPP RP-171506; <http://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_75/Tdoclist/History/>)

The work items recently approved by the TSG WG4 do not specify for country or region. Equipment operating in any of these bands could be used in any countries where the regulations are compatible with the 3GPP technical characteristics and the mobile use has been authorised by the respective nation regulator.



* 3GPP 5G New Radio (NR)

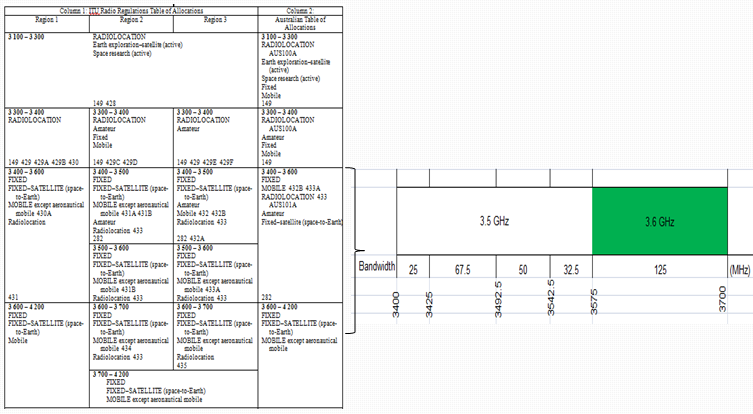
3GPP has also started specifying details for 5G NR bands including the large band of 3300-4200 MHz. The standardisation of 5G NR bands is expected to be completed by June 2018 within the 3GPP Release 15. (Reference: 3GPP RP-170847 New Work Item Description, March 2017; 3GPP TR38.802 v14.0.0 Technical Report, March 2017; <http://www.3gpp.org/ftp/TSG_RAN/TSG_RAN/TSGR_75/Tdoclist/History/>)



* Australian Radio Spectrum Plan Jan 2017

Australian allocations are broadly aligned with the International Telecommunication Union (ITU) Radio regulations requirements for Region 3 with very few variations within the 3300-4200 MHz range. (Reference: Australian Radio Spectrum Plan 2017 - with general information; <http://www.acma.gov.au/~/media/Spectrum%20Engineering/Information/pdf/ARSP%202017%20-%20with%20general%20information%20pdf.pdf>)

The table below shows the frequency allocations of ITU Radio regulations and the corresponding Australian allocations. The diagram beside the table describes the range of 3.5 GHz band and 3.6 GHz band. We also understand that the best use of 3.5 GHz band has been considered by the ACMA and will be investigated followed by re-farming of the 3.6 GHz band.



The radio spectrum is a critical and valuable asset to support growth and jobs in Australia. With increasing radio spectrum demand, for example, accelerated growth in wireless data traffic generated by smart phones, tablets, and other portable Internet access devices, it is necessary to use this unique resource as efficiently as possible.

The entire spectrum range of 3300-4200 MHz will not be identified for MBB globally, and can be different from country to country, including Australia, depending on the local conditions. It is important to define spectrum policies and actions, described below, to utilise the spectrum efficiently and to benefit from the economies of scale deriving from the ecosystem that will be developed in the range (3300-4200 MHz).

* To address current spectrum fragmentations including trading of existing licences, optimising spectrum allocation and licensing
* To align with 3GPP frequency bands- LTE-A Band42 (3400-3600 MHz), Band 43 (3600-3800 MHz) and 5G NR bands (3300-3800 MHz; 3600-4200 MHz and/or 3300-4200 MHz) as to lead to a harmonised spectrum and its use for MBB services

This frequency harmonisation requirement, as stated above in the ACMA’s spectrum planning and allocations, is vitally important because devices and UEs used commercially in Australia will have the same specifications as other regions, reducing costs.

* To define auction rules, to allow operators to access the wide blocks of contiguous unpaired spectrum in the order of 100 MHz or more
* To define plans to relocate incumbents to other frequency bands, including sharing in the short term to avoid delays in the allocation process

**OPTIONS PAPER QUESTIONS AND OUR RESPONSES**

1. **Should the 3.6 GHz band be progressed from the *preliminary replanning* stage to the *re-farming* stage in the ACMA’s process for considering additional spectrum for MBB services? Why/Why not?**

Huawei’s response:

* It is the best compromise frequency band for 5G capacity and coverage requirement with respect to intended usage scenarios for IMT 2020 and beyond, defined by the ITU-R

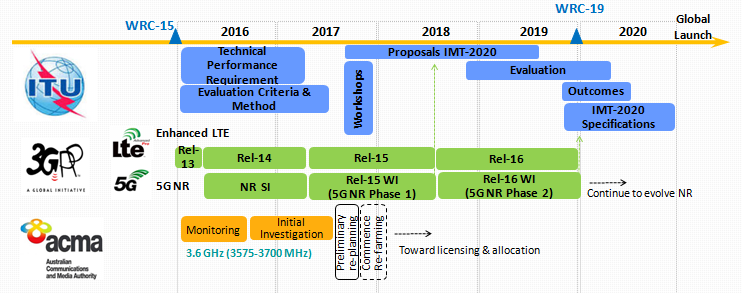
(Reference: ITU-R M.2083-0 (09/2015) - ‘IMT Vision - Framework and overall objectives of the future development of IMT for 2020 and beyond’; <http://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf>)

* It has the largest contiguous frequency range potentially available for MBB below 6 GHz for all regions – Region1, 2 and 3 includes Australia
* Equipment is available in the 3400-3800 MHz range

LTE-TDD networks and devices, including smartphones, are now commercially available in the 3600-3800 MHz band (3GPP band 43). The first 5G trials in various portion of the 3400-4200 MHz range will start at the end of 2017. GSA expects commercial readiness of the 5G-NR ecosystem in 2018, targeting broader commercialisation from 2019.

(Reference: GSA report – The future of IMT in the 3300-4200 MHz Frequency Range; <https://gsacom.com/>)

* Regulation and standardization timelines



With above evidence of band harmonisation approaches and development of global standardisation, Huawei believes that it is the right time for the 3.6 GHz band to be progressed from the preliminary re-planning stage to the re-farming stage in Australia for considering additional spectrum for MBB services.

1. **Do the areas identified in this analysis cover the likely areas of high demand for access to the 3.6 GHz band? Would smaller or larger areas be more appropriate? Why?**

Huawei’s response:

The most likely areas of high demand for 5G services and the initial network deployment will be at major metro and major regional population centres.

The most suitable path toward 5G for existing mobile network providers, as well as one of the 5G radio access roadmap in 3GPP, will be based on the Long Term Evolution (LTE).

The existing lower frequencies (e.g. 1800, 900, 700 MHz) in combination with 3.6 GHz will provide benefits for the reuse of the existing infrastructure in areas where dense networks are deployed. 3GPP LTE- Advanced Pro has introduced further enhancements for spectrum efficiency, link reliability, additional coverage, peak throughput speeds, and cell capacity with an adoption of Massive Multiple Input Multiple Output technology, Carrier Aggregations and high order modulation.

Huawei currently believes that the areas identified in this analysis cover the likely areas of high demand for 3.6 GHz band access. It is important to note that the ACMA’s framework should also embrace innovation and the latest development of 3GPP regarding the characteristics of advanced antenna systems, such as concerning unwanted emissions.

1. **If any part of the 3.6 GHz band is re-allocated for the issue of spectrum licences is seven years a suitable re-allocation period? If not, what period of time would be appropriate?**

Huawei’s response:

Huawei suggests for a suitable re-allocation period to be considered on a case by case basis as to be defined for different incumbent services and different geographical areas.

In case of a need for flexible coordination between new MBB services and incumbents, in a transition period or to protect an existing service, a license shared access approach, or similar, may be considered. This allows for initial 5G deployment areas – hotspots and dense urban while protecting certain location of remaining incumbents.

1. **Should different re-allocation periods be considered for different areas? For example, should a longer period be considered for services outside Area 1?**

Huawei’s response:

Huawei supports the ACMA’s consideration for a re-allocation period for incumbents and new users as outlined on Page 24 and 25 of “Options paper”. As commented above, **different re-allocation periods are to be considered differently for different areas and services on a case by case basis.**

One of the studies that quantifies the economic benefits that would derive from the earlier availability of the 3400-4200 MHz band shows the early availability of said band will yield significant net benefits as these could offer the MBB use, required for mobile data traffic growth.

(Reference: Use of 3300-4200 MHz spectrum for mobile broadband in cities London and Shenzhen, prepared by Plum consulting for GSMA and Huawei; <https://www.gsma.com/newsroom/press-release/new-gsma-report-reveals-economic-benefits-of-c-band-spectrum-for-mobile-broadband/>)

1. **Are these guidelines appropriate? Why?**

Huawei’s response:

Huawei appreciates the ACMA’s consideration of the issues currently faced by different licensees of adjacent geographical areas for interference and unwanted emission resolution.

Huawei has recently witnessed that licensees were unable to meet the relevant boundary emissions and interference limits even with the use of techniques such as adjusting antennae heights, lowering EIRPs, adjusting antennae down tilt, shielding with terrain, and additional sector planning. In some scenarios, licensees will need to switch off the newly built sites close to the licence boundary. This has led licensees losing their investments as well as reduced coverage for users depending on their locations and size of geographical dead zones.

Huawei supports ACMA’s guidelines which have been taken into account in assessing potential areas for replanning in the 3.6 GHz band. These stated three (3) guidelines will greatly assist licensees in resolving the geographical boundary issues by:

* Minimising dead zones as appropriate geographical lots are to be defined with larger metropolitan high demand areas
* Providing a long term plan with a certainty for investment at high value use of the spectrum as spectrum allocation will be done simultaneously across the entire areas

1. **Are there any other issues that affect the usability of an area-wide licence that should be taken into account when defining the licence area?**

Huawei’s response:

ACMA’s Options paper rightly identifies that the geographic extent of dead zones can be considerable and, in our experience, it is not always possible to implement mitigation techniques. At times network operators with an adjacency do not reach an agreement on coordination at the boundary and hence they must revert to the baseline which is very restrictive.

Huawei considers dead zones to be a significant economic loss and that the benefits of releasing spectrum regionally (in terms of flexibility) outweigh this loss. In practice, we expect that Australian operators are likely to bid for spectrum in all regions, hence the benefits of regional allocations will be limited.

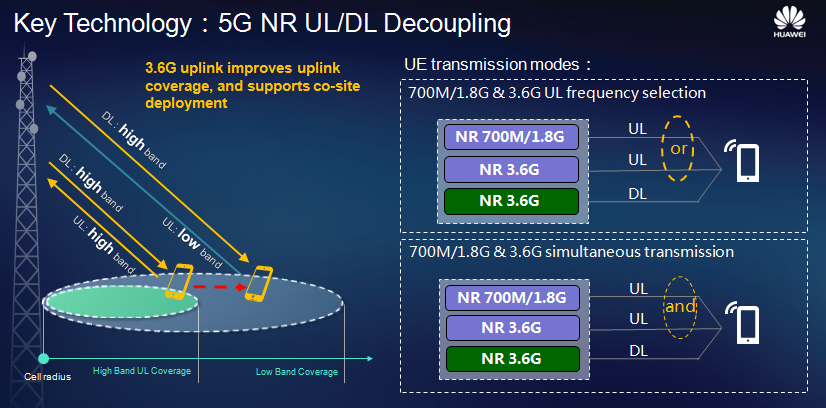
In general, Huawei will encourage the ACMA to continue with a regular review of the existing spectrum licensing technical framework to propose changes as required and when required for national constraints and international obligations.

As for this 3.6 GHz Time Division Duplexing (TDD) band, the ACMA may also wish to review 3GPP Band 43 (as well as Band 42) operating band parameters, including User Equipment (UE) specific and Base Station (BS) specific, to add and to update for national deployment requirements. The ACMA may also wish to consider for its regulatory framework innovations made by global technical specification groups that have been completed for specifications required for end to end ecosystems and services.

One of the benefits of the Time Division Duplex (TDD) Access scheme is an adoption of common synchronisation and alignment of Uplink/Downlink transmissions, which can be implemented between operators in the same areas (that means, this can be applied for a dead zone of geographical boundary area). TDD allows for the maximum use of valuable spectrum resources, as it does not require guard bands within the band. This benefit has already been proven with today commercial TDD networks.

Additionally, beam forming and massive Multiple in Multiple out (MIMO) technologies will effectively manage both interference and total emitted radio power, thus achieving a smaller dead zone.

The other feasible solution, which is also one of the 5G New Radio (NR) technical specifications Huawei’s R&D team has been working very closely with 3GPP and the industry in developing, is called “UL and DL decoupling”. Specifications of this work item are now included under 3GPP Release 15, to be a one of the fundamental techniques for NR. With this capability, as shown in the below diagram, the coverage of C-band (3.5 GHz and 3.6 GHz) will be extended by deploying with other 5G NR bands such as 700 MHz and 1800 MHz. This technique may be deployed by licensees at needed geographical locations including at the geographical boundary where the coverage issue can be resolved. (Reference: 3GPP Release 15 studies and work items page; <http://www.3gpp.org/release-15>)

**

1. **If point-to-point licences are affected by replanning activities in the 3.6 GHz band, are the options identified for point-to-point licences suitable? Are there any alternative options that should be considered?**

Huawei’s response:

The options identified for point-to-point licences are suitable. It is noted that there are only a small number of point-to-point licences and mostly are located in regional areas of Australia. For dense area new MBB deployment, reallocation of point-to-point service is necessary.

1. **Is the 5.6 GHz band a viable option for wireless broadband systems?**

Huawei’s response:

Huawei will not comment on this question.

1. **Under what circumstances should apparatus- and class-licensed arrangements be considered for the 5.6 GHz band?**

Huawei’s response:

Huawei will not comment on this question.

1. **If apparatus licensing arrangements are developed for wireless broadband systems in the 5.6 GHz band, are the notional arrangements proposed in Appendix 3 suitable?**

Huawei’s response:

Huawei will not comment on this question.

1. **If point-to-multipoint licences are affected by replanning activities in the 3.6 GHz band, are the alternative options identified suitable? Are there any alternative options that should be considered?**

Huawei’s response:

Huawei will not comment on this question.

1. **The ACMA seeks comment on the suitability of the current west coast earth station protection zone located near Mingenew, WA, for long-term satellite service use. Are the current regulatory arrangements effective?**

Huawei’s response:

Huawei supports the ACMA’s effective proposal of relocating the FSS earth stations in Western Australia to the area around Mingenew where an earth station protection zone has been established. This arrangement will provide a long-term certainty for space and satellite operations while freeing up new MBB services in highly populated areas.

1. **In the event FSS earth stations are affected by replanning activities in the 3.6 GHz band, the ACMA seeks comment on:**
2. **Any issues surrounding the development and establishment of an east coast earth station protection zone; particularly on what factors would be necessary to make it an attractive option for earth station operations.**

Huawei’s response:

A practical solution for earth station operation is important in order to swiftly progress the deployment of new entrant MBB service at high population dense area.

ITU-R has conducted a compatibility analysis of sharing scenario of FSS earth station and LTE-A mobile services. (References: 1 Sharing studies between IMT Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3400-4200 and 4500-4800 MHz frequency bands; <http://www.itu.int/pub/R-REP-M.2109>; 2.Sharing studies between International Mobile Telecommunication-Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands in the WRC study cycle leading to WRC-15; <http://www.itu.int/pub/R-REP-S.2368>)

The results from the above studies shows that the required separation distances are quite sensitive to a number of parameters and scenarios assumptions made such as the earth station horizontal antenna angle, terrain model, clutter, shielding capability and output power of interfered/interfering base station. Thus, the separation distance or guard band cannot be used for all deployment scenarios and it is to be determined on a case by case basis with close collaborations.

It is important to note that the above mentioned ITU-R studies were performed in 2007 and 2015 World Radio Conference and did not include analysis of a base station with massive MIMO. Such technology can enhance efficient mitigation techniques for avoiding signal transmitting to the direction of the interfered receiver.

Huawei is in favour for the ACMA’s development of an east coast earth station protection zone, in providing long-term security to satellite industry while enabling spectrum in more populous areas to reach its highest value use.

Huawei suggests the ACMA sets requirement guidelines for operating parameters and a technical guideline for FSS protection zones. The protection zone calculations are to be carried out with more detailed parameters including propagation and terrain data.

Furthermore, Mr. Joe Guan, Spectrum Policy Regulatory Affairs Advisor of GSMA, has reported a case study in November 2013. (Reference: Benefits of C-Band Reallocation to Mobile in APAC; <https://www.itu.int/dms_pub/itu-r/oth/0c/06/R0C060000550012PDFE.pdf>)

The report stated that the existing C-band satellite services moving to higher bands (Ku band 12-18 GHz) and (Ka band 26-40 GHz) have higher bandwidth/throughput and cost effectiveness.

The report also included rain fading dB for required availability of service. Under this study, this can be overcome by the today’s satellite technologies such as spot beams, adaptive coding, modulations and uplink power control for non critical satellite services.

Huawei will encourage the ACMA to explore this option with the Ku/Ka band, where feasible for FSS to clear the band/lessen protection zones.

1. **Whether there are any views on potential candidate locations to consider.**

Huawei’s response:

As per the ACMA’s assessment which is presented and summarised in Appendix 5 of Options paper, the Site near Moree stands out to be a suitable option to be considered for an establishment for east cost FSS protection zone among four (4) potential sites. Huawei is in agreement with the ACMA that more analysis of this location would be required before a definite decision.

1. **Whether there should there be more than one earth station protection zone on the east and west coasts of Australia.**

Huawei’s response:

Huawei will not comment on this question.

1. **If the identification of a central Australia earth station zone should be considered.**

Huawei’s response:

Huawei will not comment on this question.

1. **Are the approaches for amateurs, radiolocation services, class licensed devices and TVRO systems suitable?**

Huawei’s response:

The approach and a mitigation technique consideration for TVRO and an alternative ATV frequency option with 3300-3320/3360-3380 MHz, is considered suitable. We also have noted the information provided on page 34 of Options paper with regard to arrangements and options of incumbent services for Amateur service, Radiolocation service, and Class-licensed devices.

1. **Are there any other options for incumbent services, not identified in this paper, which should be considered?**

Huawei’s response:

Huawei will not comment on this question.

1. **Should any of the sharing arrangements discussed in this section be considered for implementation in the 3.6 GHz band? Why or why not?**

Huawei’s response:

**Where feasible, an option of relocating incumbent services and providing an exclusive licence to MBB implementation in the 3.6 GHz band is preferred.** This band is highly valuable and important for long-term investment of licensees as well as to guarantee the delivery of 5G carrier grade services.

If this is not viable, then, on a case by case basis, the reallocation to other bands/ relocating to a different location for incumbent services is not feasible; thus sharing with incumbents is inevitable and an alternative approach for sharing arrangements could be considered. Importantly, the sharing arrangement(s) will require technology development to regulatory support (in all aspects).

As already analysed by the ACMA, the sharing developments in the US as well as in Europe will allow new entrants to use the spectrum while protecting incumbents.

The Citizen Broadband Radio Service (CBRS) in the US consists of three (3) tiered users to support shared access to the band with Tier 1: Incumbent Users; Tier 2: Priority Access Licences; and Tier 3: General Authorised Access.

Licensed Shared Access (LSA) in Europe, developed by Electronic Communications Committee (ECC) has two (2) approaches as described below. It also provides a guidance to implement the LAS framework at the national level where appropriate. (Reference: ECC Report 254 Operational guidelines to support ECC framework in the 3600-3800 MHz range for sharing with Fixed Service/Fixed Satellite Service; <http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP254.PDF> )

* Approach A: Specifying the maximum permitted interference powers or electric field strengths at the FS/FSS receivers and allowing full flexibility to the mobile operators to comply with the specified limits. These may be expressed in terms of protection zones.
* Approach B: Specifying explicit restrictions on the frequency, or geographic location, or the equivalent isotropic radiated power (EIRP) levels (or a combination thereof) for the MBB deployments. These restrictions can be expressed in terms of exclusion zones and/or restriction zones.

Huawei would suggest the ACMA not to implement the three (3) tiered or multi-tiered sharing arrangement in Australia yet as to avoid a more complex sharing scenario to manage in this early development stage of adoption for spectrum sharing arrangements.

With a range of tight regulatory frameworks, the LSA would be one of the possible approaches to implement (a specific implementation of database assisted sharing between a licensee and incumbents). It is important to acknowledge the difficulties that arise with even two (2) tiered sharing opportunities before considering three (3) or more tiered sharing regulatory frameworks.

1. **Are there any other sharing arrangements that should be considered?**

Huawei’s response:

Huawei does not think that there are any other sharing arrangements that could be relevant for this band.

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

Huawei’s response:

The current presented options for replanning the 3.6 GHz band are sufficient to address the considered issues.

1. **Which replanning option should be implemented in the band? Why?**

Huawei’s response:

Huawei’s current view is that Option 3c should be implemented in the band.

We agree with the ACMA´s assessment of the benefits and costs of the different options. We also agree that spectrum licensing is necessary to deploy 4.5G and 5G MBB in high demand urban and suburban areas, whereas apparatus licensing could be sufficient for low demand areas. We emphasise that the 3.6 GHz low band is very vital for 4.5G and 5G MBB deployments to provide mobile coverage and capacity, including connecting remote unconnected areas and people.

1. **In the event an area-wide licensing option is implemented, in which of the defined areas (that is, Area 1, 2, 3 and Australia-wide as defined in Appendix 6) should these arrangements be implemented? Are the current area definitions appropriate? If not, what area should be defined?**

Huawei’s response:

In the event an area-wide licensing option is considered, Area 3 should be implemented. In the long-term, Australian-wide spectrum licensing arrangements may become relevant to deploy 5G services beyond Area 3, including rural areas, when 5G technology and its applications develop further in the future.

1. **If Option 4a is implemented, what frequencies and areas should be re-allocated for the issue of spectrum licences? How much spectrum should remain subject to site-based apparatus licensing arrangements? Should different amounts be considered in different areas?**

Huawei’s response:

Huawei does not recommend the ACMA to adopt and implement this option.

1. **If Option 4b is implemented, what frequencies and areas (that is, incumbent apparatus licence services) should remain subject to site-based apparatus licensing arrangements?**

Huawei’s response:

Huawei does not recommend the ACMA to adopt and implement this option.

1. **Comment is sought on the ACMA’s preferred option (Option 3c) for the 3.6 GHz band.**

Huawei’s response:

It is an option with a spectrum licence arrangement for MBB service in Area 3 (will be issued for a maximum of 15 years) and new site based apparatus licence arrangements for both wireless broadband services and MBB services outside Area 3.

Area 3 covers almost all high demand areas of 3.6 GHz band with exception to Peth (to avoid the issue of spectrum licences around the earth station protection zone near Mingenew). The area surrounding the earth station at Uralla, NSW is also excluded from re-allocation for spectrum licensing and suitable coordination would be required to manage interference. It also has a long-term geographical relocation of existing Area 3 earth stations in regional/remote area (location would need to be decided) if they wish to continue operating in 3.6 GHz.

Under this option, incumbent apparatus licensees deployed inside Area 3 would be required to relocate by the end of re-allocation period (transition period). Point-to-multipoint services would be relocated to the 5610-5650 MHz band in regional and remote areas initially, with consideration of release in metro areas at a later date.

This option, Option 3c, is the most viable and practical option for the current foreseen issues in 3.6 GHz band spectrum, to be re-farmed for reallocating to MBB services for Australia.

**HIGHEST VALUE USE ASSESSMENT- QUANTITATIVE ANALYSIS QUESTIONS AND OUR RESPONSES**

1. **Are there any general economic impacts that should be included but are not currently included in the method to determine highest value use?**

Huawei’s response:

Huawei commends the ACMA for conducting a value assessment of the re-farming of the 3.6 GHz band. We recognise that quantification is difficult and very sensitive to the assumptions, which in turn are subject to a great deal of uncertainty. However we agree with the ACMA that, to the extent possible, the broader economic impacts should be accounted for.

Huawei would like to emphasise the significant and direct contribution of mobile broadband to the economy. Some highlights of this can be found in the 2017 GSMA Mobile Economy Report for the Asia Pacific region which found that mobile technologies and services generated 5.2% of GDP in Asia-Pacific, a contribution that amounted to around USD1.3 trillion of economic value. The mobile industry supported 16 million jobs in 2016 in the region, including workers directly employed by the industry and jobs in support of the economic activity generated by the sector. The mobile industry also makes a substantial contribution to the funding of the states, with approximately USD166 billion raised in 2016 in taxes.

Mobile services are also an engine for growth, with an econometric study commissioned by the GSMA in 2012 concluding that a doubling of mobile data use leads to an increase in GDP per capita of 0.5 percentage points.(Reference: Report from Deloitte for GSMA, What is the impact of mobile telephony on economic growth?, November 2012; <https://www.gsma.com/publicpolicy/wp-content/uploads/2012/11/gsma-deloitte-impact-mobile-telephony-economic-growth.pdf>)

In addition, mobile broadband creates significant broader social value, beyond the private value for consumers and providers of the service or the taxes that the industry pays. Typical sources of social value associated with mobile include access, inclusion and quality of life. Mobile Broadband can support remote education and facilitates access to information and culture to residents of rural areas. It also aids the elderly and those from disadvantaged social groups by improving their connection with relatives and care workers. Mobile Broadband can also improve the quality of life of citizens by supporting eHealth technologies, empowering the disabled, and facilitating a better work-life balance (for example, allowing parents of young children to work from home).

In summary, mobile broadband is a major contributor to welfare in modern society. This is clear from its direct contribution to the wealth of nations, the jobs it creates and the taxes its pays. It is also clear from it is contribution to better connected, informed and empowered citizens.

1. **Are there any other spectrum valuations (for example, domestic or international auction prices or re-issue prices) that should be considered as a guide to the value of the 3.6 GHz band?**

Huawei’s response:

Several countries have released spectrum in the 3400-3800 MHz range in the last 10 years through a competitive award. Italy, Romania and Ireland held auctions in 2008, 2015 and May 2017 respectively. Of these awards, we believe the Irish one to be the most relevant for Australia. The technologies available and the expected uses at the time of the Italian and Romanian awards were different from those available today and in the coming years. In particular, the 3400-3800 MHz spectrum has been used in Europe for fixed wireless access using 4G or WiMax technologies until now, but 5G mobile broadband will be deployed under the Irish licenses (and the Australian licenses).

The Irish award has made available 350 MHz in the 3400-3800 MHz block. (The lower 3400-3410 MHz is left out as guard band, and the 3435-3475 MHz block is preserved for State Services). The award released spectrum in 9 non-overlapping regions. There were 5 companies that obtained spectrum in the award: Imagine, Airspan, Vodafone, Three and Meteor Mobile. These companies will pay in excess of €78m for the rights of use, split in €60.5 million in upfront fees and €17.7 million in spectrum usage fees, which will be paid in annual instalments over the 15 year duration of the licences.(Reference: Results of the 3.6 GHz Band Spectrum Award, ComReg Document 17/38; <https://www.comreg.ie/media/dlm_uploads/2017/05/ComReg-1738.pdf>)

Using these numbers, the average price paid per MHz per population for a 15 year licence is EUR 0.0486/MHz/pop which translates to AUD0.07/MHz/pop using the current exchange rate. This is on the low side of the range that the ACMA has proposed in the consultation ($0.03 to $0.625 / MHz/pop) and in our view a better representation of the value that operators are likely to put in this band.

1. **Is the range of $/MHz/pop values suitable for this analysis, or is there a case to narrow or broaden the range?**

Huawei’s response:

The outcome of the Irish award gives us with an up to date valuation of $0.07/MHz/pop for a 15 year licence for spectrum in this range, made available for mobile broadband. In our view, this is more likely to be closer to reality than older valuations or valuations for other bands. Therefore we think there is a case to narrow the range by removing the lowest valuation i.e. $0.03/MHz/pop and the valuations above $0.2/MHz/pop.

1. **Would there be a change in the quality of services that could be provided by WISPs with the 5.6 GHz band compared with the incumbent 3.6 GHz band services?**

Huawei’s response:

Huawei will not comment for this question.

1. **What alternative internet services could regional consumers access (excluding NBN Sky Muster services) if WISPs are unable to provide their fixed wireless broadband services?**

Huawei’s response:

Mobile wireless broadband could be considered as an alternative internet service. Fixed Wireless Access and Smart Home is one of the application examples for 5G operating in 3300-4200 MHz.

1. **How could the loss of point-to-multipoint licences in the 3.6 GHz band affect regular business operations for non-WISP licensees?**

Huawei’s response:

Huawei will not comment for this question.

1. **Are the applicable costs for equipment replacement and re-tuning for point-to-multipoint licences suitable? If not, what cost ranges should be applied?**

Huawei’s response:

Huawei will not comment for this question.

1. **Are there any additional costs (applicable under a Total Welfare Standard) that have not been considered in this analysis?**

Huawei’s response:

The ACMA has already pointed out that the cost, particularly in variable output cases, may not be able to be quantified.

Additionally to the current estimated re-farming benefits which were derived from potential users of MBB, there will be other indirect effects over the nation’s economy. These include:

* Employment and New business creation
* Government Income (Spectrum licences proceedings; Additional tax income from increased economic activity such as corporate taxes, value added taxes)
* Multiplier effect on wider economy

(Reference: Asia Pacific Mobile Observatory, Driving Economic and Social Development through Mobile Broadband, Studied by AT Kearney in 2011; <https://www.gsma.com/publicpolicy/wp-content/uploads/2012/03/amofullwebfinal.pdf>)

1. **If the 3.6 GHz band is re-farmed, what is the extent to which a longer re-allocation period would reduce incremental costs under a TWS?**

Huawei’s response:

Huawei will not comment on this question.

1. **Is the cost range for the relocation of all C-band licences from an FSS earth station facility suitable for this analysis?**

Huawei’s response:

Huawei is not in a position to comment on the cost range analysed by the ACMA for the relocation of all C band licences from an FSS earth station facility. However, we wish to provide a reference, one of the studies prepared by Frontier Economics Pty. Ltd, Australia for the GSMA. (Reference: Economic assessment of C-band re-allocation; <https://www.gsma.com/spectrum/wp-content/uploads/2014/11/GSMA.-Frontier-report-on-Economic-assessment-of-C-band-re-allocation-2014.pdf>)

We recognise that the cost estimation model of Frontier is based on some assumptions, including the main usages of satellite industry from Northern Sky Research (NSR) and some cost savings arising from using shared facilities. The result from their cost estimation for Australia is from PPP USD 11 million to PPP USD 43 million.

1. **Are the applicable costs for equipment replacement and re-tuning for point-to-point licences suitable? If not, what cost ranges should be applied?**

Huawei’s response:

Huawei will not comment on this question.

1. **To what extent would 3.6 GHz band spectrum be less valuable if it was restricted to small cell use only?**

Huawei’s response:

Huawei is not in a position to comment on the quantitative loss of value that results from a restriction to small cell use only, however we believe this loss could be significant. Huawei believes operators are likely to use this band for mobile broadband in urban and suburban areas initially, with the objective of adding a high data rate overlay to existing LTE networks.

Huawei and the rest of the industry are working hard to reach 5G coverage footprints in the 3.6 GHz band that are similar to those attained by LTE in lower bands such as the 1.8 GHz band. This is achievable in the downlink direction by means of massive MIMO antennas, but not in the uplink where there are no benefits from MIMO at the transmitter. As a result, we expect that this band will be deployed initially at existing sites, where the uplink from existing LTE deployments can be used at locations close to the cell edge. This approach would let Mobile Network Operators significantly enhance the capacity and data rates in the downlink without having to deploy new sites – they will upgrade existing sites with the new technology – but maintaining the coverage footprint.

If the MBB use is restricted to small cells, then re-using existing sites alone would not be sufficient to provide the benefits of 5G at all locations that have 4G coverage today. Mobile Network Operators would have to deploy new sites to maintain the same level of coverage. This would greatly increase their costs and the complexity of the network and would, from our perspective, a disincentive to deploy 5G in this band in the areas subject to restriction.

1. **What kind of differences in value would there be for 3.6 GHz band spectrum in regional or remote areas when compared with metropolitan areas?**

Huawei’s response:

We believe that spectrum in rural or remote areas is normally less valuable that in urban areas as the population to be served is smaller and the area to be covered is larger (hence there is less opportunity for profit for the operator). However, regional and remote areas can still be a business opportunity for operators. For instance, Fixed Wireless Access is a service more commonly provided in non-urban areas and can be profitable. Another source of value comes from providing mobile service along motorways or rail lines. Finally, rural coverage has, in some cases, been used by operators as a marketing tool and a way to differentiate themselves from competitors.

A data point that the ACMA might find useful is the relation between the amounts bid for urban and for rural licences in the Irish auction. The operator “Imagine Communications” only bid for – and obtained – licences in the four rural regions of the Irish auction, for a total of 60 MHz in each. Imagine paid EUR0.053/MHz/pop for the 15 years licences, whereas the average of the auction (the average of the prices paid by all winning bidders for urban and rural licences) was EUR0.048/MHz/pop, which is slightly lower. Therefore Imagine, which is a WISP in Ireland, seems to put more value in access to this band in rural areas than Mobile Network Operators put in access at urban and rural combined. However, it is worth noting that the total population in the four Irish regions identified as “rural” is higher than the population of urban areas, and the geographical size of Ireland is small compared to Australia. These considerations might explain Imagine Communications´ higher valuation.

**About Huawei**

Huawei is a leading global information and communications technology (ICT) solutions provider. Through our dedication to customer-centric innovation and strong partnerships, we have established end-to-end advantages in telecom networks, devices and cloud computing. We are committed to creating maximum value for telecom operators, enterprises and consumers by providing competitive solutions and services. Our products and solutions have been deployed in over 140 countries, serving more than one-third of the world’s population.

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