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Introduction

Qualcomm Inc. (Qualcomm) welcomes the opportunity to provide input to the Australian Communications and Media Authority (ACMA) on the *Wireless broadband in the 26 GHz band Options Paper* (Options paper).

Qualcomm Incorporated is a world leader in advanced wireless technologies including 3G, 4G, 5G, WiFi and next-generation wireless. For more than 30 years, Qualcomm's ideas and inventions have driven the evolution of digital communications, linking people everywhere more closely to information, entertainment, and each other. Qualcomm Technologies, Inc., a wholly-owned subsidiary of Qualcomm Incorporated, is the world's largest fabless semiconductor producer and the largest provider of wireless chipset and software technology, which powers a large portion of the wireless devices commercially available today. Our technologies are powering the convergence of mobile communications and consumer electronics making wireless devices and services more personal, affordable and accessible to people everywhere. We are redefining the experience of wireless mobility by applying our unmatched legacy of wireless innovation to enable new generations of increasingly powerful cell phones, smartphones, computers and consumer electronics, and Internet of Things (IoT) devices. Today, we license nearly our entire patent portfolio to more than 300 manufacturers worldwide – from new market entrants to large multinational companies. Qualcomm's business model has created a pro-competitive, pro-innovation value chain of global scale whose ultimate beneficiaries are consumers.

When considering 5G, Qualcomm urges continued identification of unutilized and underutilized frequencies in low, mid, and high bands in order that spectrum is put to its highest-value use. Qualcomm's vision is for 5G to enable new services and devices, connect new industries, and empower new user experiences. We are developing a unified 5G system addressing both licensed and unlicensed spectrum and frequency bands below 6 GHz, as well as higher bands above 6 GHz, including the 26 GHz band. 5G will be driven by heterogeneous services with vastly different requirements – from very low energy sensors, wearables and new form factors, to new mission critical applications with high reliability and low latency (e.g., smart city and critical infrastructure, medical and emergency response, sensing and remote control), to very high data rate backhaul and access transmissions across wide bandwidths for ultra-high capacity broadband. 5G will be a new platform with the scalability and adaptability to cost efficiently support new wireless applications, services, and deployment models for 2019-2030 and beyond. The 26 GHz band and other millimeter wave (mmWave) bands will be a crucial input to enable the 5G-powered expanded wireless ecosystem.

In line with this purpose, Qualcomm strongly supports ACMA's actions intended to make the greatest possible portion of the 26 GHz band available for 5G use in Australia at the earliest feasible date, and appreciates the opportunity to provide comments in this consultation process. mmWave spectrum, in conjunction with sub-6 GHz spectrum, is critical to delivering the full benefits of 5G NR to Australian consumers, industry and government. Australia has been the home to many mobile technology world's firsts (e.g., Gigabit LTE). Various other countries have already taken decisions to release mmWave spectrum for 5G and commercial deployments have begun. If Australia wishes to maintain this technology leadership, and not fall behind other countries' we strongly encourage the ACMA to accelerate its process and timeline to release 26 GHz frequency spectrum in 2019.

The remainder of this submission presents information on Qualcomm's recent mmWave 5G announcements, views on the timing for release of the 26 GHz band, and responses to the individual questions posed in the Options paper.

Qualcomm mmWave 5G technology

Qualcomm continues to lead 5G and mmWave technology development, announcing new products and partnerships intended to enable deployment of 5G services in bands including 26 GHz. In May 2018, Qualcomm Technologies, Inc. introduced the industry's first 5G New Radio (5G NR) solution targeted for small cells and remote radio head deployments (FSM100xx), which will support deployments in both mmWave and sub-6 GHz spectrum. This highly flexible solution is designed to enable original equipment manufacturers (OEMs) to reuse both software and hardware designs across sub-6 and mmWave products, supporting high-bandwidth and robust coverage for mobile subscribers around the globe. Small cell densification is expected to be a critical component of 5G network deployments and FSM100xx readies the industry to develop powerful and uniform 5G user experiences, taking advantage of the full range of 5G spectrum types.

Qualcomm also announced in October 2018 the introduction of additions to the QTM052 mmWave antenna module family of fully-integrated 5G NR mmWave modules for smartphones and other mobile devices. The new reduced-size module is engineered to enable mobile device manufacturers to address stringent mobile handset size requirements for 5G NR smartphones and mobile devices that will enable commercial launches in 1H 2019. The QTM052 mmWave antenna modules include an integrated 5G NR radio transceiver, power management integrated circuit (IC), radio frequency (RF) front-end components and phased antenna array as well as support for up to 800 MHz of bandwidth in the 26.5-29.5 GHz (3GPP band n257), 27.5-28.35 (3GPP band n261), and 37-40 GHz (3GPP band n260) mmWave bands. The QTM052 mmWave antenna modules are designed to work with Qualcomm's Snapdragon X50 5G modem family, which are designed to enable the next generation of premium-tier mobile cellular devices, while also aiding operators to execute early 5G trials and commercial deployments.

Global OEMs Select Qualcomm® Snapdragon™ X50 5G NR Modem Family for Mobile Device Launches in 2019

Qualcomm and Mobile Device OEMs Focus on Delivering Next-Generation 5G Mobile Experiences with Low Latency, Extreme Capacity and Fiber-Like Connectivity to the Cloud



Commercial networks and smartphone devices integrating the 5G NR modems from the Snapdragon X50 family will be launched in 1H 2019 enabling a broad range of new use cases, such as: concert venues, indoor enterprise networks, and enterprise shop or factory floors.

5G NR mmWave boosts performance in Enterprise networks



Downlink/uplink coverage comparable to Wi-Fi with 1:1 or partial co-site



Realize multi-Gigabit burst rate with wider bandwidths (e.g., 800 MHz)



Complement indoor Wi-Fi deployments

Coverage simulation based on MIMO (maximum allowable path loss) analysis with ray-trace propagation model and measured material and propagation loss. Maximum DL/UL 1:1: 800 MHz downlink, 800 MHz uplink. Maximum Allowable Path Loss (UL 1:1: 800 MHz UL 1:1: 800 MHz DL, bandwidth and 100 MHz uplink bandwidth with 71 DL/UL TDD.





The slide above indicates important Qualcomm announcements relative to 5G ecosystem readiness. In addition to those indicated Qualcomm has also collaborated with infrastructure and device OEM/ODMs to ensure interoperability of devices across networks and mmWave and sub-6 GHz bands.¹ More information on Qualcomm's 5G research and collaboration efforts can be found at <https://www.qualcomm.com/invention/5g>.

All of these announcements indicate that the ecosystem is ready to support the acceleration of 5G network and mobile device deployments, allowing the industry to utilize several spectrum bands from the outset. These also highlight the need for governments to follow industry developments and review their spectrum planning in order to make available mmWave spectrum in the near term.

Accelerated access to 26 GHz spectrum is critical

As indicated in the *Five-year Spectrum Outlook 2018-2022* (FYSO 2018-2022), the ACMA currently anticipates an auction of the 26 GHz band in Q1-2 2020-2021 (corresponding to the second half of calendar year 2020). Qualcomm strongly urges the ACMA to reconsider this timeline and provide earlier access to this band. Qualcomm, through the continued development of solutions such as the X50 5G modem family, is bringing technology to market to enable widespread commercial 5G deployments and devices as early as 2019.

If the ACMA determines that it cannot release the entire 26 GHz band in 2019 as originally envisioned, it may be appropriate to consider a two-stage auction. Specifically, offering 26-27.5 GHz at the earliest possible opportunity in 2019, followed by 24.25-26 GHz in 2020, would enable stakeholders the ability to begin deployment of mmWave 5G networks and delivery of services to Australian users while preparing for a follow-on auction that will allow for increased bandwidths and improved user experience. Such an approach would enable Australia to participate in early stages of 5G deployment, leveraging the portion of the 26 GHz band that is likely to be the first to see commercial deployments in Europe, China, and

¹ <https://www.qualcomm.com/news/releases/2017/12/21/global-mobile-industry-leaders-achieve-multi-band-5g-nr-interoperability>.

elsewhere, bringing benefits through economies of scale in network infrastructure and user devices. Qualcomm encourages the ACMA to consider this or similar approach in order to prevent Australia from lagging behind many other countries on 5G mmWave commercialization, and missing out on the capacity enhancements, associated new use-cases (e.g. immersive VR/AR) and potential new businesses opportunities and other benefits mmWave delivers.

It is critical to emphasize that several countries are already moving forward with their plans to assign 26 GHz spectrum for 5G services, and on timelines that are ahead of what the ACMA currently proposes. A representative sample of such plans is included in Table 1.

Table 1: 26 GHz assignments anticipated before 2020

Country	Band	Assignment Date
Italy	26.5-27.5 GHz	October 2018
Qatar	26.5-27.5 GHz	2018
Russia	26 GHz	Q1 2019
Germany	24.25-27.5 GHz	2019
Hong Kong	24.25-28.35 GHz	2019
Sweden	26.5-27.5 GHz	2019/2020
France	26 GHz	2019/2020
Spain	26 GHz	2019/2020
United Kingdom	26.5-27.5 GHz	2019/2020
China	26 GHz	Expected to be allocated to IMT in 2019

In addition, in July 2018 the United States Federal Communications Commission released a Notice of Proposed Rulemaking which seeks comment on use of the 26 GHz band for commercial mobile services such as 5G.²

As noted in Qualcomm’s comments on the *Spectrum for broadband in mmWave bands* consultation, industry’s effort to accelerate the timeline for bringing 5G to market creates incentives for the ACMA to accelerate consideration of the 26 GHz band in order to ensure that adequate spectrum is available to enable Australian carriers, businesses, and consumers to benefit from 5G technology. By moving quickly, including taking a more proactive assignment approach, the ACMA would better enable Australia to be

² Third Further Notice of Proposed Rulemaking on “Use of Spectrum Bands Above 24 GHz for Mobile Radio Services,” U.S. Federal Communications Commission ([FCC-18-73A1.pdf Opens a New Window](#)).

among the early adopters of 5G services, reaping the multitude of economic and social benefits brought to Australian consumers, industry and the government.

Responses to Options paper questions

- 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?**

No comment.

- 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 ACMA should make available the greatest possible amount of spectrum for 5G in the 26 GHz band, regardless of the stance taken by CEPT. Qualcomm believes that the CEPT approach is excessively cautious with respect to protection of passive EESS and will result in unnecessary limitations on the utility of the lower portion of the 26 GHz band. Instead, in line with other industry stakeholders, Qualcomm recommends less stringent emission limits, both in Australia and elsewhere.

For comparison, Table 2 presents emission limits proposed by various stakeholders for base stations (BS) and user equipment (UE).

Table 2: Proposed 26 GHz emission limits for EESS protection

Stakeholder	Emission limits
ITU-R Working Party 5D (WP 5D) (original)	BS and UE: -20 dB(W/200 MHz)
3GPP input to WP 5D	BS and UE: -37 dB(W/200 MHz), noting that for BS to support this value, frequency separation between the two systems on the order of 1 GHz would be required
3GPP (supported by ASMG and ATU)	BS: -32 to -37 dB(W/200 MHz) UE: -28 to -30 dB(W/200 MHz)
CEPT	BS: -42 dB(W/200 MHz) UE: -38 dB(W/200 MHz)

CEPT's more stringent limits will result in a guard band that will preclude the use of the lower part of the 26 GHz band for 5G services in the short-to-medium term, with the longer-term outlook uncertain. In addition, discussions on this subject are ongoing within Europe, and further work is necessary to determine the appropriate limits and guard bands. Further, should Europe opt to maintain CEPT's current guidance, it is possible that the European approach will not be adopted across all of Region 1, with both the African and Arab regions considering ranges of -28 to -30 for mobiles and -32 to -37 for base stations

in inputs to Task Group 5/1 (TG 5/1) of the International Telecommunication Union (ITU) Radiocommunication Sector (ITU-R). There has also been discussion within the Inter-American Telecommunications Commission (CITEL) to agree on emission limits that are less restrictive than those agreed by CEPT. Further work is underway within the mobile industry and other regional groups to arrive at appropriate limits, less stringent than those from CEPT, and which protect the EESS while not overprotecting which would be detrimental to 5G deployments and terminals.

While European activities may restrict 5G services in Europe in the lower portion of the band and lead to underutilization, the ACMA's approach should include reasonable steps to protect EESS without precluding use of the lower portion of the band for delivery of 5G services. It is also important that Australia engage at the international level to guarantee that the outcome of the 2019 World Radiocommunication Conference (WRC-19) results in an appropriate limit to protect EESS (passive) while also making the most efficient use of the band for 5G.

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

As noted in Qualcomm's comments on the *Spectrum for broadband in mmWave bands* consultation, demand for 5G services and greater network capacity is likely to be highest in metropolitan areas, and the final licensing approach for 26 GHz should ensure that those areas receive the earliest possible access. Qualcomm supports offering initial availability of 26 GHz spectrum to the widest possible areas. Such an approach would enable the early introduction of 5G in those areas where there are likely to be the most initial users.

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

Qualcomm supports a spectrum licensing approach that maximizes certainty of long-term access to wide-area broadband users, namely award of the 26 GHz on an exclusive, spectrum-licensed basis. This is in line with Qualcomm's 5G spectrum policy approach and takes into consideration Australia's particular spectrum usage and geographic characteristics. The highest value use of the 26 GHz band will be enabled by exclusive wide-area licensing. Such an approach will enable Australia to make the best use of its mmWave spectrum. The certainty provided by an exclusive spectrum licensing approach in the 26 GHz band will provide not only certainty in terms availability of spectrum for 5G, but also a stable network investment environment aimed at providing predictable network performance for a diverse range of 5G use cases. Implementation of apparatus-licensing or class-licensing regimes will only serve to divert resources, whether in terms of spectrum or in terms of required ACMA administration and monitoring, from deployment and successful operation of spectrum-licensed services.

Prior to the 26 GHz spectrum release/auction, ACMA should allow for 5G NR commercial trials using temporary apparatus licenses.

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

In line with Qualcomm's response to Questions 3 and 4, Option 2d (spectrum licensing of 24.25-27.5 GHz in metropolitan areas and regional centers) is the ideal choice for 26 GHz licensing in Australia. In particular, spectrum licensing is crucial for enabling wide-area network deployments, which are expected to provide the highest value use of the band. The addition of apparatus licensing and/or class licensing

will only serve to reduce the value of the band and divert resources away from the successful deployment and operation of wide-area spectrum-licensed services.

As noted in our response to Question 3, access to 26 GHz spectrum across the largest feasible geographic area is the best choice for maximizing access to this key 5G spectrum band. As such, spectrum space option “d” is the preferred choice among the options presented. To the extent that it is feasible to license an even larger geographic area, Qualcomm encourages the ACMA to do so.

With respect to the upper boundary of the 26 GHz band, Qualcomm strongly encourages the ACMA to release **up to 27.5 GHz** for 5G in order to provide sufficient spectrum for multiple network operators. As indicated in the Options paper and in the *National positions and developments in the 26 GHz band* report, a number of European countries are considering **initial allocations only in the 26.5-27.5 GHz band**. The ACMA should, therefore, take steps to maximize harmonization as this will ensure Australia has access to mmWave 5G in the earliest possible timeframe.

- 6. If options 3 or 5 (all variants) are preferred, how much of the band should be available for spectrum licensing and apparatus licensing?**
- 7. If options 4 or 5 (all variants) are preferred, how much of the band should be available for class licensing?**

As indicated in response to Question 4, Qualcomm believes spectrum licensing is the most appropriate approach for this band in Australia. While a class licensing regime provides benefits for certain use cases, we do not see a compelling case for allowing in 26 GHz.

- 8. If options 4 or 5 (all variants) are preferred, what conditions should be applied to a class license 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)?**

Please see response to Question 7.

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

Noting that the ACMA intends to continue its work on the suitability of the 28 GHz band, Qualcomm encourages the ACMA to undertake a 26 GHz planning approach that will allow for the easiest possible coordination with potential 28 GHz licensing approaches. Both the 26 GHz and 28 GHz bands are expected to be key 5G enablers around the world, and the ACMA should make every effort to ensure that the plans for one will not have a negative impact on the other, preserving Australia’s ability to leverage both the 26 GHz and 28 GHz ecosystems for 5G.

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

No comment.

Conclusion

Qualcomm welcomes the opportunity to convey our views to the ACMA regarding the *Wireless broadband in the 26 GHz band Options Paper*. We strongly support the ACMA's efforts to provide a conducive environment for the deployment of mmWave-enabled 5G technology, and urge the acceleration of the process and timeline so that spectrum can be released in 2019, as originally envisioned.

Should you have any questions or comments on this submission, please do not hesitate to contact me at +852 6348 6687 (mobile) or juliewelch@qti.qualcomm.com.

Sincerely,

A handwritten signature in blue ink that reads "Julie Garcia Welch". The signature is fluid and cursive, with the first name "Julie" being the most prominent.

Julie G. Welch
Vice President, Government Affairs, Asia Pacific
Qualcomm Inc.

cc: Alex Fernandez, Senior Director, Business Development, Qualcomm Australia & New Zealand