Qualcomm

www.qualcomm.com

August 22, 2018

Office of the Communications Authority
29/F., Wu Chung House
213 Queen's Road East
Wan Chai
Hong Kong
(Attention: Head, Regulatory 3)

Email: consult-26-28GHz@ofca.gov.hk

Qualcomm Incorporated (Qualcomm) welcomes the opportunity to provide input to the Communications Authority (CA) and the Secretary for Commerce and Economic Development (SCED) on the *Proposed Allocation of the 26 GHz and 28 GHz Bands to Mobile Service and the Associated Arrangements for Spectrum Assignment and Spectrum Utilization Fee* (the Consultation).

Qualcomm is a world leader in 3G, 4G, and the development of 5G and other advanced wireless technologies. 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 is the world's largest fabless semiconductor producer and the largest provider of wireless chipset and software technology that powers many wireless devices commercially available today in Hong Kong and around the world. We are a recognized world leader in the research and development of advanced wireless technologies and continue to bring technology enhancements to market. Since our founding, Qualcomm's philosophy has been to enable many other companies in the wireless value chain to succeed. Today, we license nearly our entire patent portfolio to 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.

Qualcomm's vision for the future is that everything around us will be connected and intelligent. 5G will be at the center of this future, providing enhanced mobile broadband, ultra-low-latency for mission-critical services and scalable bandwidth to connect massive IoT. Qualcomm has been working on new 5G designs for many years, building upon our long-standing expertise in 3G, 4G, and Wi-Fi, and we are leading the technology innovations that will make 5G a reality in 2019. To this end, Qualcomm Snapdragon X50 5G NR modem chipset solutions will be released to original equipment manufacturers/original device manufacturers (OEMs/ODMs) by the end of 2018, allowing for delivery of commercial user devices, including the smartphone form factor, in 1H 2019.

In this response, Qualcomm comments on the role of the 26 GHz and 28 GHz bands, provides updates on 5G and the progress of 5G standardization, and presents responses to specific questions posed by the Consultation.

1.1 Responses to Consultation Questions

Question 1: What are your views on the proposed allocation of the 26/28 GHz bands to mobile service and of the sub-band of 24.25 – 24.45 GHz to fixed service, both on a primary basis? What are your views on the protection of radio stations of co-primary users on a first-come-first-served basis?

Qualcomm supports the intent of the CA to allocate the 26 GHz and 28 GHz bands to the mobile service. As noted in the Consultation as well as past stakeholder outreach efforts, the 26 GHz and 28 GHz bands have been the subject of considerable attention as possible bands for 5G deployments and both are expected to be key bands for 5G deployments. The 26 GHz band is already under study for 5G at the International Telecommunication Union (ITU) and the 28 GHz band is expected to enable early 5G deployments. In conjunction with an assignment of the spectrum for the provision of mobile services, the allocation will allow these bands to be employed to bring the greatest possible value to Hong Kong's citizens, businesses, and government.

The current usage of the 26 GHz and 28 GHz bands in Hong Kong, combined with the CA's 2017 notices withdrawing 26 GHz assignments to Fixed Service (FS) licensees by April 1, 2019, create a favorable environment for the deployment of 5G services. In particular, the absence of any fixed satellite service (FSS) or radionavigation service licensees in the 26 GHz band and the absence of FS or FSS licensees in the 28 GHz band, combined with the protection of radio stations of co-primary users on a first-come, first-served basis should allow the deployment of 5G services without undue constraints.

5G mmWave development occurring prior to January 2018 are detailed in Qualcomm's submission to the the CA's *Invitation for Expression of Interest in Using the Spectrum in the 26 GHz and 28 GHz Bands for the Provision of Fifth Generation Mobile Services.* Additionally, during 2018, governments and regulators have continued to make strides toward the timely deployment of 5G networks and services leveraging mmWave spectrum. For example:

- In India, a 5G spectrum advisory panel's preliminary findings identified the 24 GHz and 28 GHz bands as immediately available for assignment for 5G services.[1] The panel's final report is expected during August 2018.
- In the United States, the Federal Communications Commission (FCC) has established bidding procedures for the 28 GHz and 24 GHz auctions scheduled to begin in November 2018.[2] In addition, the FCC has proposed the next steps to prepare the upper 37 GHz, 39 GHz, and 47 GHz bands for auction in the second half of 2019.[3]
- South Korea completed an auction including 28 GHz spectrum in June 2018.[4]
- New Zealand's spectrum management authority published a 5G discussion document that considered the use of 26 GHz spectrum for 5G services.[5]

[1] The Economic Times, "5G panel identifies 6000 Mhz spectrum as available for next gen service," (June 17, 2018), available at https://economictimes.indiatimes.com/industry/telecom/telecom-policy/5g-panel-identifies-6000-mhz-spectrum-as-available-for-next-gen-service/articleshow/64622114.cms.

[2] FCC, "Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auctions 101 (28 GHz) and 102 (24 GHz)," (August 3, 2018), available at https://docs.fcc.gov/public/attachments/FCC-18-109A1.pdf.

[3] FCC, "Fourth Further Notice of Proposed Rulemaking, Use of Spectrum Bands Above 24 GHz For Mobile Radio Services," (August 3, 2018), available at https://docs.fcc.gov/public/attachments/FCC-18-110A1.pdf.

[4] Ministry of Science and ICT, "Final 5G Mobile Communication Auction Results," (June 18, 2018), available at http://www.msit.go.kr/web/msipContents/contentsView.do?cateId=mssw311&artId=1386500.

[5] Ministry of Business, Innovation, and Employment Radio Spectrum Management, "Preparing for 5G in New Zealand: Discussion Document," (March 2018), available at https://www.rsm.govt.nz/projects-auctions/current-projects/preparing-for-5g-in-new-zealand/technical-consultation/5g-spectrum-road-map-discussion-document.pdf.

In addition, industry has continued its work to enable the manufacture and availability of commercial 5G devices. Qualcomm is a pioneer in mmWave technology, announcing its first 5G modem, the Snapdragon X50, in October 2017, and having already shown the world that it is possible to use high-frequency bands in a mobile handset.[6]In particular, Qualcomm announced the first commercial 5G New Radio mmWave antenna modules and sub-6 GHz RF modules for smartphones and other mobile devices in July. The QTM052 mmWave antenna modules work in tandem with the Snapdragon X50 5G modem, as a comprehensive system, to help overcome the formidable challenges associated with mmWave. They support advanced beam forming, beam steering, and beam tracking technologies, drastically improving the range and reliability of mmWave signals. They feature an integrated 5G NR radio transceiver, power management integrated circuit, RF front-end components, and phased antenna array. They support up to 800 MHz of bandwidth in the 26.5-29.5 GHz band (n257), as well as the entire 27.5-28.35 GHz (n261) and 37-40 GHz (n260) bands.[7]

Our engineers have been collaborating with handset OEMs/ODMs to bring these features to market. The development of the QTM052 modules leveraged Qualcomm's collaboration with Vivo, a leading Chinese handset OEM, on 5G antenna technology. Together with Vivo, we announced a collaboration on breakthrough technologies and designs that integrate 28 GHz mmWave antenna arrays into a commercial smartphone form factor which also uses sub-6 GHz technologies in June.[8] The subsequent demonstration of 5G mmWave coexisting with sub-6 GHz in a commercial form factor is groundbreaking work enabled by Qualcomm and critical to the commercial launch of 5G. Further, our knowledge of the overall wireless system and understanding of global operator requirements add value to the ecosystem as they move towards implementation.

The entire mobile industry continues to work toward the development and deployment of 5G technology. In June 2018, the Third Generation Partnership Project (3GPP) approved the completion of the first specification for a new wireless air interface (5G New Radio or 5G NR) that comprised Non-standalone and Standalone operation.[9] As noted in Qualcomm's comments on the CA's *Invitation for Expression of Interest in Using the Spectrum in the 26 GHz and 28 GHz Bands for the Provision of Fifth Generation Mobile Services*, the mobile industry, led by Qualcomm, worked together to accelerate the 3GPP standardization timeline for 5G NR. Due to these efforts, the first 5G NR global standard networks and devices will now be commercially deployed in 2019, underscoring the importance of allocating and assigning spectrum for 5G.

This accelerated timeline was made possible through the introduction of an intermediate milestone to complete technical specifications related to a configuration called Non-Standalone (NSA) 5G NR. In December 2017, 3GPP completed NSA 5G NR specifications, defining the first phase of the global 5G standard. NSA 5G NR will utilize the existing LTE radio and core network as an anchor for mobility

[6] See, for example, "Making 5G NR mmWave a reality for 2019 smartphones," at https://www.qualcomm.com/news/onq/2017/10/05/making-5g-nr-mmwave-reality-2019-smartphones.
[7] Qualcomm, "Qualcomm Delivers Breakthrough 5G NR mmWave and Sub-6 GHz RF Modules for Mobile Devices," (July 23, 2018), available at https://www.qualcomm.com/news/releases/2018/07/23/qualcomm-delivers-breakthrough-5g-nr-mmwave-and-sub-6-ghz-rf-modules-mobile.
[8] More information is available in "Enabling the ecosystem: Unlocking 5G's potential with breakthrough antenna tech," available at https://www.qualcomm.com/news/onq/2018/06/22/enabling-ecosystem-unlocking-5gs-potential-breakthrough-antenna-tech.
[9] This specification is known as Release 15, https://www.3gpp.org/release-15

management and coverage while adding a new 5G carrier. This is the configuration that will be the target of early 2019 deployments.

In comparison to NSA 5G NR, Standalone (SA) 5G NR implies full user and control plane capability for 5G NR, utilizing the 5G next-generation core network architecture (5G NGC) also being developed in 3GPP. The work completed in December, including definition of a framework to ensure commonality between the NSA and SA variants, will benefit both NSA and SA 5G NR variants. The completion of SA 5G NR technical specifications in June 2018 that complement the NSA specifications not only gives 5G NR the ability of independent deployment, but also brings a brand new end-to-end network architecture, making 5G a facilitator and an accelerator during the intelligent information and communications technology improvement process of enterprise customers and vertical industries.

Considering the availability of the 26 GHz and 28 GHz bands and the ongoing industry progress, Qualcomm supports the CA's proposal to allocate the 26 GHz and 28 GHz bands to the mobile service, as well as the protection of radio stations in these bands on a first-come, first-served basis. By proactively planning for early spectrum releases, the CA will position Hong Kong to be at the forefront of 5G deployments and to benefit from new and enhanced 5G services.

Question 2: Do you have any views on adopting an administrative assignment approach for the release of spectrum in the 26/28 GHz bands?

No comment.

Question 3: Do you have any views on the proposed band plan with frequency slots of 100 MHz each?

5G will require large contiguous blocks of spectrum, especially in the mmWave bands, to realize its full potential. Qualcomm supports the CA's proposal to employ an assignment mechanism that will enable licensees to acquire such blocks, in order to enable rich multimedia enhanced mobile broadband (eMBB) user experiences. Specifically, the plan would allow multiple 100 MHz carriers to be aggregated to provide greater bandwidth while providing flexibility for licensees to obtain the amount of spectrum that will meet their needs. Similar to the experience with aggregation of LTE carriers, combining multiple 100-MHz spectrum blocks will drive greater spectrum usage efficiency in the delivery of 5G eMBB in mmWave bands. As noted in the Consultation, this provides the flexibility to make spectrum available to different numbers of applicants, each of whom may have a different business plan or use case.

As also noted in the consultation, the mobile industry is already developing equipment that will enable operators to aggregate spectrum in multiples of 100 MHz in order to provide the best possible user experience.

Question 4: Do you have any views on the proposal of assigning (a) 3 300 MHz to 3 700 MHz of spectrum in the 26/28 GHz bands for the provision of large scale public 5G services; and (b) the remaining 400 MHz to 800 MHz of spectrum in the two frequency bands to other entities for the provision of 5G services in specified locations on a shared basis?

In considering how to assign spectrum in the 26 GHz and 28 GHz bands, sufficient spectrum should be provided to enable large-scale public 5G service operators to acquire an amount of spectrum up to the spectrum cap. Qualcomm supports the CA's plan to assign a minimum of 3300 MHz for the provision of large-scale public 5G services. This approach, in conjunction with the proposed 800 MHz per operator

limit, should provide enough spectrum for each of the four incumbent mobile operators to obtain the maximum amount of spectrum and deliver high-quality 5G services to Hong Kong's individuals, businesses, and all other end users.

The remaining 26 GHz and 28 GHz spectrum may be useful for providing private and/or location-specific 5G services. This will provide an opportunity for entities to serve campuses such as industrial parks, science parks, and factories. In these settings, 5G technologies could be used for targeted applications, notably the industrial Internet of Things (IIoT). This would improve options for such campuses and organizations to leverage 5G networks for uses such as automation, location tracking, and asset and operations monitoring, among others.

Question 5: Do you have any views on the proposed caps of (a) 800 MHz of spectrum in the 26/28 GHz bands for spectrum designated for the provision of large scale public 5G services; and (b) 400 MHz of the Shared Spectrum designated for the provision of specified location services?

Qualcomm supports the proposed limit of 800 MHz for large-scale public 5G services. Given the amount of spectrum proposed for the provision of such services, an 800 MHz limit should provide the opportunity for operators to obtain enough spectrum to take advantage of the 800 MHz carrier aggregation technology that has already been announced, such as in Qualcomm's X50 modem.

A limit of 800 MHz would be in line with the recent auction of 28 GHz spectrum in South Korea. In that auction, bidders could each acquire up to 1,000 MHz of spectrum in the band, and ultimately each of the three bidders obtained 800 MHz in the 28 GHz band.[10]

Question 6: What are your views on the proposed method of assigning spectrum in the 26/28 GHz band to qualified applicants for the provision of large scale public 5G services?

No comment.

Question 7: Do you have any preference on the assignment of spectrum in either the 26 GHz or 28 GHz band?

The 28 GHz band is expected to enable early 5G deployments, particularly noting that Japan, Korea, and the United States have taken action to enable development in the 28 GHz band. The United States has adopted a decision allowing deployment of 5G services, focusing on mmWave spectrum bands including the 27.5-28.35 GHz band. Japan has assigned spectrum in the 27.5-29.5 GHz band for trials and expects to launch commercial 5G services by 2020, and South Korea has completed an auction including 26.5-29.5 GHz spectrum in June 2018.

[10] Ministry of Science and ICT press release, available at http://www.msit.go.kr/cms/www/m_con/news/report/__icsFiles/afieldfile/2018/05/04/180504%20EC%A1%B0%EA%B0%84%20(%EB%B3%B4%EB%8F%84)%205%EC%84%B8%EB%8C%80%20EC%9D%B4%EB%8F%99%ED%86%B5%EC%8B%A0%20EC%A3%BC%ED%8C%8C%EC%88%98%20ED%95%A0%EB%8B%B9%20EA%B3%B5%EA%B3%A0.pdf.

Question 8: What are your views on the proposed assignment method for the Shared Spectrum?

No comment.

Question 9: What are your views on the network and service rollout obligations proposed to be imposed on the use of spectrum assigned for the provision of large scale public 5G services?

No comment.

Question 10: What are your views on the proposed performance bond for guaranteeing compliance with the proposed network and service rollout obligations for using spectrum assigned for the provision of large scale public 5G services?

No comment.

Question 11: Do you have any views on the proposal for SUF as set out in paragraphs 45 to 50 above?

No comment.

1.2 Conclusion

Qualcomm is encouraged by the continued CA and SCED efforts to ensure the availability of adequate mmWave spectrum to enable deployment of 5G services in Hong Kong in the earliest possible timeframe. The CA's proactive approach to allocating and assigning the 26 GHz and 28 GHz bands will enable all stakeholders to plan for successful 5G deployments that deliver enhanced and innovative services to Hong Kong's users while maximizing harmonization with global and regional developments.

We appreciate the opportunity to provide feedback to the CA and SCED and would be pleased to provide further information or respond on greater detail. Should you have any questions or comments on this submission, please do not hesitate to contact me at +852 69010087 (mobile) or aorange@qti.qualcomm.com .

Sincerely,

Alex Orange
Director, Government Affairs, South East Asia, Taiwan and Pacific
Qualcomm Incorporated