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Email: consult-3.5GHz@ofca.gov.hk

Re: Arrangements for assignment of the spectrum in the 3.4 – 3.6 GHz band ("3.5 GHz band") for the provision of public mobile services and the related spectrum utilisation fee ("SUF")

Qualcomm welcomes the opportunity to provide input to the Communications Authority and the Secretary for Commerce and Economic Development's Consultation paper on *the arrangements for assignment of the spectrum in the 3.4 – 3.6 GHz band ("3.5 GHz band") for the provision of public mobile services and the related spectrum utilisation fee ("SUF")* ("Consultation Paper").

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 which 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. Qualcomm's business model has created a pro-competitive, pro-innovation value chain of global scale whose ultimate beneficiaries are consumers.

Qualcomm is broadly supportive of OFCA's proposals and intentions to bring the 3.4 – 3.6 GHz spectrum to market using transparent market based mechanisms and unlocking the economic potential of 5G. In this response information is provided to ensure: the auction and spectrum license design preserves the flexibility inherent in the standardized 5G technology to provide a range of service types encompassing URLLC, eMBB, and massive IoT; spectrum efficiency is maintained; and that the potential for interference between mobile networks in adjacent frequency spectrum is minimized.

Question 1: Do you have any views on assigning the spectrum in the 3.5 GHz band through an auction?

Qualcomm agrees with the Communication Authority's consideration that there will be competing demands for the radio spectrum in the 3.5 GHz band, and that there will be an excess of demand. It is therefore appropriate to use a market based approach, such as an auction, to assigning the 3.5 GHz band.

Question 2: Do you have any views on the proposed band plan with division of the available spectrum into ten frequency blocks, each with a bandwidth of 20 MHz?

Question 3: Do you have any views on the proposed spectrum cap of 100 MHz to be imposed on any bidder in the auction?

In section 5 of 3GPP Technical Standard Release 15, band plans for bands n77 and n78, corresponding to the 3300 – 4200 MHz and 3300 – 3800 MHz respectively, have been specified, with a range of carrier bandwidths including those of multiples of 20 MHz up to a maximum bandwidth of 100 MHz. Basing the auction design on lot units of 20 MHz that may be aggregated accommodates a variety of bidding strategies and provides for a range of outcomes with bidders obtaining differing bandwidths.

Question 4: Do you have any views on the proposed format of and timing for the auction?

In order to maximize the benefits of spectrum for 5G, it is important that spectrum is assigned in large, contiguous blocks that will provide the flexibility and spectrum resources needed to deploy 5G services and ensure a high quality of service. The Communications Authority's choice of a Clock format to ensure each operator being assigned contiguous spectrum will improve overall spectrum efficiency, by minimizing the need for and number of guard bands between operators.

In February 2018, multiple global wireless network operators in both the sub-6 GHz and millimeter wave (mmWave) spectrum bands selected the Qualcomm Snapdragon X50 5G modem for use in live, over-the-air mobile 5G NR trials. AT&T, British Telecom, China Telecom, China Mobile, China Unicom, Deutsche Telekom, KDDI, KT Corporation, LG Uplus, NTT DOCOMO, Orange, Singtel, SK Telecom, Sprint, Telstra, TIM, Verizon and Vodafone Group will conduct the trials, which will be based on the 3GPP Release 15 5G NR standard. The planned trials underscore the readiness of Qualcomm Technologies' mobile 5G NR solution in a smartphone form factor and aim to commercialize standard-compliant 5G NR products and services over the coming year. Furthermore, Qualcomm® Snapdragon™ X50 5G NR modem family has been selected by a number of global original equipment manufacturers (OEMs) for standard-compliant 5G NR mobile device product launches starting in 2019. Those working with Qualcomm Technologies include OEMs such as Asus, Fujitsu Limited, Fujitsu Connected Technologies Limited, HMD Global – the home of Nokia phones, HTC, Inseego/Novatel Wireless, LG, NetComm Wireless, NETGEAR, OnePlus, OPPO, Sharp Corporation, Sierra Wireless, Sony Mobile, Telit, vivo, Wingtech, WNC, and Xiaomi. These OEMs are working to commercialize 5G mobile devices for the sub-6 GHz and millimeter wave (mmWave) spectrum bands as early as 2019.

Considering the planned availability of mobile devices, and completed over-the-air mobile 5G NR trials, the demand for 5G NR services, and expected economic benefits that 5G NR will bring to Hong Kong, Qualcomm encourages the Communications Authority to maintain, or even bring forward the timing to the earliest practicable opportunity.

Question 5: Do you have any views on the proposed ONA requirement?

No comment.

Question 6: Do you have any views on the proposed requirements [for protection of TT&C stations] as set out in paragraphs 29 to 31 above?

So that occupants of the Stanley and Tai Po enjoy access to 5G services in the 3.5 GHz band as equitably and early as possible when compared to occupants of other areas of HK, Qualcomm suggests that OFCA consider the application of mitigation measures to improve the RF isolation between IMT stations and satellite TT&C stations. By incorporating RF isolation improvements into coordination calculations, the

extent of the exclusion zones and guard band requirements may be reduced. Released guard band may be utilized for additional 5G services.

Mitigation measures may include, *inter alia*; additional shielding applied to TT&C receive antennas, tailoring TT&C antenna radiation patterns and elevation angles for specific satellites and their orbits, and taking advantage of local features for the siting of IMT base-station antennas.

Question 7: Do you have any views on the proposed subsidy scheme for the upgrade of existing SMATV systems, including the funding and administrative arrangements for issuing the amount of subsidies to the affected system owners/users?
No comment.

Question 8: Do you have any views on the adoption of a technology neutral approach in respect of the use of spectrum in the 3.5 GHz band?
In general, Qualcomm supports the technology neutral approach proposed in the consultation. However, when deploying TDD networks in adjacent spectrum additional considerations must be made to avoid interference between the networks, and maintain the inherent flexibility of 5G NR to deliver different use cases.

Multiple TDD carriers operating in adjacent channels create the potential interference unless mitigation measures are implemented. Mitigation measures include the use of guard bands, network synchronization and isolation using filtering.

For 5G systems employing adaptive antenna systems (AAS) additional base station OOBE filtering is not feasible as the antenna panel cannot be augmented with external filters.

Network synchronization involves selection of a common frame UL/DL structure and time synchronization of the beginning of the frame. However, Synchronization of TDD LTE systems with a typical 5G frame structure is not possible, and synchronization of 5G systems with the LTE frame structure has severe consequences on the performance of 5G networks by reducing capacity and increasing latency.

Regulators, like OFCA, may employ a number tools to prevent such unfortunate consequences and enable deployment of true 5G networks, they may:

- Adopt a 5G ready regulatory framework developed such as that in ECC Report 281.
- Limit synchronization requirements to necessary cases only.
- Encourage and facilitate MNO discussion to identify an overall synchronization framework enabling 5G and innovation.

Question 9: Do you have any views on the proposed network and service rollout obligations, as well as the associated performance bond to be imposed on successful bidders?
No comment.

Question 10: Do you have any views on the proposals in relation to SUF above?
No comment.

Summary
Qualcomm commends the Communications Authority and the Secretary for Commerce and Economic Development's for consulting on *the arrangements for assignment of the spectrum in the 3.4 – 3.6 GHz band ("3.5 GHz band") for the provision of public mobile services and the related spectrum utilisation fee ("SUF")* and in response encourages OFCA to take account of the technical information provided in this submission and to proceed with haste towards the assignment of spectrum for the benefit of all Hong Kong. In the meantime, Qualcomm will provide additional relevant technical information from 3GPP and regional forums as it becomes available.

Sincerely,

Alex Orange
Director, Government Affairs, Southeast Asia, Taiwan & Pacific
Qualcomm Incorporated