Qualcomm Europe Inc.

CONSULTAZIONE PUBBLICA SULLE PROCEDURE PER L'ASSEGNAZIONE E LE REGOLE PER L'UTILIZZO DELLE FREQUENZE DISPONIBILI NELLE BANDE 694-790 MHz, 3600-3800 MHz e 26.5-27.5 GHz PER SISTEMI TERRESTRI DI COMUNICAZIONI ELETTRONICHE AL FINE DI FAVORIRE LA TRANSIZIONE VERSO LA TECNOLOGIA 5G, AI SENSI DELLA LEGGE 27 DICEMBRE 2017, N. 205

Qualcomm's comments

April 2018

Qualcomm welcomes the opportunity to provide comments to AGCOM on the proposed auction rules for the 700 MHz, 3.6 – 3.8 GHz and 26.5 – 27.5 GHz bands.

Qualcomm would like to congratulate AGCOM on its efforts to release spectrum in 2018 to enable the deployment of 5G in the county as early as in 2019. The deployment of 5G NR technology on top of gradually proliferating Gigabit LTE networks will bring to consumers in Europe and in Italy significant advances in wireless network performance. Availability of new spectrum in the 700 MHz, 3.5GHz and 26GHz bands is the key to unlocking the full potential associated with 5G. It is very valuable for 5G players to be in a position to select the most appropriate spectrum strategy combining 700 MHz, 3600-3800 MHz and 26GHz assets.

5G will be a unified design, scalable and adaptable across extreme variations in requirements to address a variety of use cases across all spectrum bands and types (licensed, shared and unlicensed) from below 1 GHz (e.g 700 MHz) for wide area coverage deployments to higher bands up to 6 GHz (e.g. 3.4 – 3.8 GHz) for more capacity focused deployments, to above 6 GHz and mm Wave (e.g 26 GHz) for extreme bandwidth and more targeted capacity deployments. Bands already harmonized below 1 GHz, including particularly the 700 MHz band, are important for 5G in order to enable nationwide and indoor 5G coverage. The importance of the 700 MHz band is not only due to its large coverage benefits, but also to the role it is expected to play for the future of 5G in Europe as 5G is expected to deliver not just improved mobile broadband, but critically a technology platform for the emergence of so-called verticals. 5G technology will enable verticals such as M2M/IoT and broadcasting to benefit from performance and economies of scale that can only be delivered by the mobile ecosystem. The 3400-3800 MHz frequency range offers an optimal balance between coverage and capacity, which will support a broad range of 5G applications, including: Augmented Reality/Virtual Reality (AR/VR), Ultra High Definition (UHD) video, smart home, smart manufacturing, health care and drones. The 3400-3800 MHz band will also provide both mobile connectivity "on the go" and Fixed Wireless Access (FWA) for domestic and business applications. 5G will also open up new mmWave opportunities for mobile broadband. The abundant spectrum available at these high frequencies is capable of delivering extreme data speeds and capacity that will reshape the mobile experience (please see attached whitepapers).

Please find attached the following whitepapers:

- augmented-and-virtual-reality-the-first-wave-of-5g-killer-apps
- whitepaper-making-5g-nr-a-reality

Release of the 26 GHz

This band will enable multi-gigabit data rates to be delivered within 5G networks, with dense spatial re-use and flexible configuration of spectrum, enabling both access and backhaul services to be provided. Qualcomm strongly believes in mmWave as a fully

mobile system and has invested heavily in research to fully understand mmWave performance under various mobility conditions and to commercialize the system for mobility from day one. This was partly done to solve the "harder problem" as by enabling a fully mobile mmWave system, FWA implementation can be derived as they are by nature less demanding.

Qualcomm expects the 24.25-27.5 GHz to be used throughout Europe also for Industry 4.0 applications and expect both Mobile Network Operators (MNOs) and vertical players to operate networks and applications in this band. 5G trials in mmWave are proliferating around the world and a number of announcements have been made by chipset, terminals and infrastructure manufacturers on products availability in 2018 - 2019 timeframe. In particular, it could be useful for AGCOM to know that the first commercial products featuring Qualcomm Snapdragon X50 5G NR modems are expected to be available in 2019.

In particular, given the situation in the country, Qualcomm do support AGCOM efforts to:

- Award the 26.5 – 27.5 GHz in 2018 as this range appear to be lightly used in the country and it can benefit from the wide and global eco-system of equipment, devices and chipsets for deployments in the US, Korea and Japan. In Europe, this approach is likely to be taken in a number of countries including UK, Germany, Spain, Portugal, Sweden and Finland. This approach to the release of the 26 GHz band starting with the 26.5 – 27.5 GHz range first is in line with the RSPG opinion on 5G as this argued for member states to make part of the band (at least 1 GHz) available before 2020.
- Award 5 blocks of 200 MHz each with national individual licenses and set a cap at 400 MHz as this could enable the deployment of 5G networks over contiguous blocks of spectrum of at least 400MHz.

- Introduce the club use concept coupled with dynamic use of spectrum to allow MNOs to use up to 1 GHz of contiguous spectrum where other license holders are not using their spectrum and/or giving the possibility to members of the club to make commercial agreement to share spectrum and networks while allowing wholesale access to verticals under certain conditions.

Last but not least Qualcomm would like support AGCOM proposed access obligations for this band. In particular, Qualcomm support the measures enabling non MNOs (with plans to offer 5G services) to have access to capacity in the 'wholesale' form or to have access to spectrum. These measures would make the band attractive and enable access for verticals or for those players serving verticals.

Release of the 3.4 – 3.8 GHz band

Availability of spectrum is a key requirement to enable development, testing and early deployment of 5G before 2020 and we do believe that the 3400-3800 MHz will be the primary band in the spectrum between 1 GHz and 6 GHz for the introduction of 5G in Europe before 2020.

In particular, given the situation in the country, Qualcomm believe that it is critical to release the maximum possible amount of spectrum in the 3400-3800 MHz and ensure that licensees have access to wide contiguous spectrum assignments in the order of 100MHz.

Thus, we do support AGCOM efforts to de-fragment the 3400 – 3600 MHz band and would like to encourage AGCOM to continue developing a plan and execute on it with the objective to make available at least additional 100 MHz in the 3.4 – 3.6 GHz in the medium term.. Furthermore, Qualcomm support AGCOM's option to award two national individual licenses associated to 2 blocks of 100 MHz each in the 3600 – 3800 MHz band as we believe that this option will allow licensees to reap the full benefits of

this frequency range for 5G. We also support AGCOM decision in terms of proposed cap (100 MHz in the 3400 – 3800 MHz).

In terms of technical regulation to comply with, Qualcomm understands AGCOM decision to award the band 3600 – 3800 GHz according to the existing European and national regulation at the time of the auction and support AGCOM intention to update the national regulatory framework in conformity with the revised ECC DEC 11(06) and potentially with revised binding EC decision as soon as they are available and to make it mandatory to comply with the revised regulation.

Qualcomm would like to draw AGCOM attention on potential issues that could arise from adjacent channel compatibility between innovative 5G networks and networks based on previous generation technologies as this would potentially restrict the potential performance of 5G networks in the band. Recognizing the importance of such a matter, at its last meeting, ECC approved a new work item dealing with synchronization in the 3.4 – 3.8 GHz band.

The benefits of 5G NR are fundamentally tied to the 5G frame structure. The full benefits of 5G will not be available is the LTE frame structure is imposed to 5G networks in order to achieve LTE-5G compatibility. 5G NR aligned with LTE frame will not meet IMT-2020 URLLC and eMBB latency requirements. The alignment would result in higher UE memory cost, TCP performance loss and mobility performance loss.

Qualcomm is finalizing a study on the impact of imposing the LTE frame structure on the performance of 5G NR networks. Qualcomm will forward this study to AGCOM as a complement to this response as soon as the study is finalized. From a regulatory standpoint, Qualcomm stresses that 5G deployment should have priority in the band and that, should frame alignment be mandated, 5G innovative frame should be selected as reference.

Last but not least Qualcomm would like to offer AGCOM its views on the proposed coverage and access obligations for this band. In particular, Qualcomm:

- Support the introduction of access obligations in favor of third parties that do not have (directly or indirectly) mobile spectrum usage rights – access obligations should be based on fair and not discriminatory commercial conditions and priority should be given to players with plans to deploy national services.
- Support the introduction of such access obligations in the form of use-it-or-lease it.
- Believe that it would be interesting to introduce the idea of spectrum pooling where possible in the case AGCOM adopts the option of 4 blocks of 50 MHz though we strongly recommend not to adopt this option as it would lead to the deployment of far from optimal 5G services.

Release of the 700 MHz band

Qualcomm understands the current situation in Italy on the 700 MHz band and the planned release schedule spanning from 2018 to 2022. That said, Qualcomm encourage AGCOM to work with the incumbents following the award of the 700 MHz band to try and make it available before 2022 and ideally by 2020 as this would lead to substantial benefits for the country. The importance of the 700 MHz band is not only due to its large coverage benefits, but also to the role it is expected to play for the future of 5G in Europe, as recently highlighted by RSPG that has identified this band as a 5G pioneer band in Europe.

The 700 MHz could play a big role to enable new services and connectivity leading to 5G should also be taken into account when addressing the optimum use of the center gap. Throughout Europe, 5G is expected to deliver not just improved mobile broadband, but critically a technology platform for the emergence of so-called verticals. 5G technology will enable verticals such as M2M/IoT and broadcasting to benefit from

performance and economies of scale that can only be delivered by the mobile ecosystem. Such verticals and services will be based on new business models and on partnerships between vertical players, mobile technology vendors and network operators – in other words vertical services will be supported by a horizontal 5G technology ecosystem. Vertical services over 5G have the potential to deliver the next growth phase for both the vertical domains considered and the mobile ecosystem.

Moreover, a recent Analysys-Mason study highlighted the significant benefits that the 733-736/788-791 MHz would provide for the emergence of M2M/IOT services supporting QoS. Qualcomm recommends AGCOM to award the 733-736/788-791 MHz to an MFCN network under a spectrum award procedure designed to favor networks delivering M2M/IOT services. These 2 x 3 MHz spectrum blocks are not included in the current auction – Qualcomm would like to point out that the inclusion of such spectrum in the award is not incompatible with the spectrum on offer for SDL in the 738 – 758 MHz band.

Furthermore, given the situation in the country, Qualcomm do support AGCOM efforts in reserving 2 x 5 MHz in the 700 MHz band and 200 MHz in the 26 GHz band for the new entrant to the Italian market. It is interesting to observe that a player in the US market has similar mix of spectrum assets to launch 5G services in the country. We also support awarding a total of 20 MHz for SDL (4 blocks of 5 MHz).