

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of

Promoting Investment in the 3550-3700 MHz
Band

GN Docket No. 17-258

REPLY COMMENTS OF QUALCOMM INCORPORATED

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January 29, 2018

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Qualcomm hereby submits these reply comments in response to the opening comments on the FCC’s Notice of Proposed Rulemaking to make certain revisions to the regulations governing the 3550-3700 MHz band (the “3.5 GHz Band”).¹ As explained below, Qualcomm greatly appreciates the broad support for its proposed emissions mask for the 3.5 GHz Band over the more graduated mask proposal that also is under consideration. Multiple parties recognize that the Qualcomm proposal is needed so this important mid-band spectrum band can successfully support wider bandwidth 4G LTE Advanced and 5G New Radio (“NR”) mobile broadband operations.

Qualcomm is eager to enable the deployment of small cells and user devices that use the 3.5 GHz Band because network densification via such small cells will deliver better, faster mobile broadband to consumers. Updating the emissions limits as Qualcomm has proposed as soon as possible will further U.S. investment in the 3.5 GHz Band and help the U.S. continue its global 5G leadership as the next generation technology is launched commercially this year.

¹ See *Promoting Investment in the 3550-3700 MHz Band*, GN Docket No. 17-258, Notice of Proposed Rulemaking and Order Terminating Petitions, FCC 17-134 (Oct. 24, 2017) (the “NPRM”).

INTRODUCTION

Many commenters recognize that the 3.5 GHz Band will play a significant role as one of the core mid-range bands for 5G network deployments throughout the world.² For this reason, it is important that the Commission promptly revise the 3.5 GHz Band emissions limits as detailed herein. A number of commenters echo Qualcomm’s point of view, noting that the current 3.5 GHz Band rules penalize operations with channel bandwidths of 20 MHz or greater by requiring devices using these wider bandwidths to engage in power back-off (so-called Additional-Maximum Power Reduction or A-MPR), thereby diminishing the quality of mobile broadband service that could otherwise be provided to consumers.³

T-Mobile explains that Qualcomm’s proposal will best enable channels of 20 MHz and wider, which are used widely in other bands by 4G LTE Advanced and which will be crucial for both 4G and 5G NR mobile operations in both the Priority Access License (“PAL”) and General Authorized Access (“GAA”) tiers of the CBRS band.⁴ Indeed, the proposed FCC rule change is needed to “keep up with technological advancements, create incentives for investment, encourage efficient spectrum use, support a variety of different use cases, and promote robust network deployments [using the band] in both urban and rural communities.”⁵

² See, e.g., Comments of CTIA at 2; Comments of Ericsson; Comments of Nokia; *see also* NPRM at ¶¶ 2, 54.

³ See TIA Comments at 4; T-Mobile Comments at 18-19; Verizon Comments at 18; *see also* Nokia Comments at 6-10.

⁴ See T-Mobile Comments at 19.

⁵ NPRM at ¶ 2. *See also* Amplex Electric Comments at 3 (“[R]elaxing the emissions limits when aggregating channels [is a] helpful improvement[] in the CBRS rules.”).

DISCUSSION

I. Multiple Commenters Want The FCC To Adopt Qualcomm's Proposal To Revise The 3.5 GHz Band Emissions Limits To Support 20 to 40 MHz Wide Channels

Multiple commenting parties support Qualcomm's proposal to revise the 3.5 GHz Band emissions limits to fully enable 4G LTE and 5G NR channels wider than 10 MHz.⁶ As Qualcomm has explained, the current 3.5 GHz Band emissions limits require significant signal attenuation outside the channel of operation and thus force mobile devices using a 20 MHz channel bandwidth to implement approximately 4 dB A-MPR to comply.⁷ Reducing the transmit power level for channel bandwidths of 20 MHz and greater by more than half significantly diminishes signal coverage, service quality, and the overall usefulness of the band for mobile operations — all without any corresponding benefit.

As we explained in our opening comments, Qualcomm's proposed emissions mask offers the best means of enabling wider bandwidth operations without materially impacting the maximum power allowed, while the graduated mask proposal would require substantial power reduction without offering much practical impact in terms of efficient channel assignments.

A. Qualcomm's Exhaustive Technical Analysis Of The Three Masks Demonstrates That Its Proposed Mask Is Superior To The Other Options

Qualcomm thoroughly analyzed the current emissions mask and the two alternative emissions mask proposals in the NPRM — the Qualcomm proposal and the so-called graduated proposal — by running an exhaustive series of operational simulations. We simulated every

⁶ See Nokia Comments at 2, 6-10; TIA Comments at 4; T-Mobile Comments at 18-19; Verizon Comments at 18; and see Ericsson Comments at 8 ("5G services in particular benefit from wider channels, and changes to the emissions mask to accommodate channels wider than 10 MHz will increase the utility of PALs."); Amplex Electric Comments at 3; Motorola Solutions Comments at 7.

⁷ See, e.g., Qualcomm Comments (filed Dec. 28, 2017).

power waveform for all possible resource block allocations for 20 MHz, 30 MHz and 40 MHz-wide channels, analyzing a total of 30,282 waveforms. Qualcomm assessed the impacts on each waveform under the Commission’s current emissions mask, the Qualcomm proposed mask, and the more complex graduated mask.⁸

The summary of Qualcomm’s analysis, which was provided in Tables 1A and 1B of our opening Comments, shows that Qualcomm’s proposed mask is superior. The graduated mask requires a transmit power reduction exceeding the amount required by the Qualcomm proposal of as much as 2.5 dB for 20 MHz channels, 1.3 dB for 30 MHz channels, and 0.8 dB for 40 MHz channels.⁹ Thus, the graduated proposal penalizes operations with channels of 20 MHz or greater far more than the Qualcomm proposal and with no corresponding benefit.

Our analysis demonstrates three key points. *First*, the current 3.5 GHz Band emissions mask needs to be changed because it forces 3.5 GHz Band licensees deploying channels 20 to 40 MHz wide to engage in significant power reduction, which impacts coverage, diminishes the utility of the band, and undermines an operator’s ability to broadly deploy wider bandwidths.

Second, Qualcomm’s emissions proposal offers the best means of improving the mask to allow wider bandwidth operations with minimal impact on the maximum allowed transmit power level. The Qualcomm proposal allows for less power back-off than the graduated emissions

⁸ The simulations used Quadrature Phase-Shift Keying (“QPSK”) digital modulation, and 23 dBm/10 MHz EIRP. While our analysis used the QPSK 4G LTE waveform, we expect to receive the same results with 5G NR. Note that 4G LTE uses Single-Carrier Frequency-Division Multiple Access (“SC-FDMA”) in the uplink direction (*i.e.*, user device to small cell), while 5G NR uses SC-FDMA as well as CP-OFDM in the uplink direction.

⁹ Qualcomm explained in its opening Comments that an across-the-board power reduction overrides any potential benefit that the graduated mask may offer in terms of less interference to unsynchronized adjacent channel operations. Synchronizing adjacent channel operations improves systemwide performance and are thus preferable regardless of the emissions mask that the FCC adopts.

proposal for low resource allocations, while both proposals require similar power back-off where there is high resource allocation.

Third, the graduated mask does not offer much practical impact on interference due to the possible existence of unsynchronized operations in adjacent channels — either alternative proposed in the NPRM can have issues with such unsynchronized operations. As Qualcomm explained in its opening comments, the wireless industry is aware of this technical issue and is working closely to address the concern.

B. The -40 dBm/MHz Additional Protection Level Requirement That Applies Above 3720 MHz Fully Protects Adjacent C Band Incumbent Operations

Qualcomm's analysis shows that channels at the band edge are dominated by the -40 dBm/MHz emissions limit that applies below 3530 MHz and above 3720 MHz, which virtually all commenters agree is needed to protect adjacent incumbent operations. Revision of the emissions limits as proposed in the NPRM would not reduce any protection for operations above 3720 MHz or below 3530 MHz. The protection to those adjacent band operations comes from the -40 dBm/MHz limit, which Qualcomm does not propose to change.

Some commenters oppose any changes to the emissions limits on the grounds that they allegedly will insert higher levels of noise into the 3700-3720 MHz portion of the adjacent C band.¹⁰ Qualcomm's analysis shows that 3.5 GHz Band operations in channels on the band edge would be constrained by the same amount as the existing emissions mask due to the -40 dBm/MHz additional protection level that protects adjacent incumbent operations. Table 1B of our opening comments shows that the current emissions mask, the Qualcomm emissions

¹⁰ See Content Companies Comments; National Association of Broadcasters Comments. Cf. NCTA - The Internet & Television Association Comments at 18-19 (expressing support for emissions limit changes to accommodate wider bandwidth channels so long as they do not adversely impact adjacent C-band users).

proposal, and the graduated emissions proposal are all equally constrained by the -40 dBm/MHz additional protection level in Rule Section 96.41(e)(2). Therefore, there will not be any increase in the noise levels in the 3700-3720 MHz portion as a result of the proposed emissions changes due to the fact that the additional protection level remains in place.

Nokia agrees with our assessment that because the Qualcomm emissions proposal does not modify the -40 dBm/MHz additional protection level in FCC Rule Section 96.41(e)(2), the suggested changes would not have any increased negative impact to the incumbents in the adjacent spectrum bands.¹¹ TIA similarly explains that the current emissions limits that apply in-band provide “no greater protection for adjacent channel operations”¹² when compared to the two proposals in the NPRM.

To be clear, we reiterate our support of the FCC’s proposal to maintain the additional - 40 dBm/MHz protection level in Rule Section 96.41(e)(2) to protect adjacent band operations, despite the fact that the additional protection level necessitates the use of A-MPR for channels operating near the lower and upper edges of the 3.5 GHz Band.

¹¹ See Nokia Comments at 2.

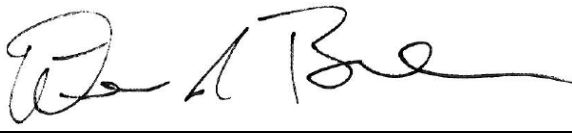
¹² TIA Comments at 4.

CONCLUSION

Over past decade, Qualcomm has done extensive work on small cell technology, and we are very excited by the upcoming deployment of 4G and 5G technologies using small cells in the 3.5 GHz Band. Based on our own detailed technical analysis and the record support for Qualcomm's emissions mask proposal, we strongly recommend that the FCC adopt our proposal. Modification of the emissions limits for PAL and GAA operations pursuant to Qualcomm's proposal will enable wider bandwidth mobile operations that 4G LTE Advanced networks can use today and 5G NR networks soon will use to support Gigabit mobile broadband service.

Respectfully submitted,

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