Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of
Amendment of the Commission’s Rules with
Regard to Commercial Operations in the 3550-
3650 MHz Band

COMMENTS OF QUALCOMM INCORPORATED ON
PETITIONS FOR RECONSIDERATION

Dean R. Brenner
Senior Vice President, Government Affairs
John W. Kuzin
Senior Director, Regulatory
1730 Pennsylvania Avenue, N.W.
Suite 850
Washington, D.C. 20006
202.263.0020

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GN Docket No. 12-354

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QUALCOMM Incorporated (“Qualcomm”) hereby comments on the Petitions for
Reconsideration filed in the above-captioned proceeding to support certain requests made in
CTIA’s Petition for Reconsideration and to address related concerns raised in the Satellite
Industry Association (“SIA”) Petition for Reconsideration, as discussed below.¹

INTRODUCTION & SUMMARY

Qualcomm supports the CTIA Petition’s requests to modify the 3.5 GHz emissions and
interference limit regulations in new rule section 96.41(e). See 47 C.F.R. § 96.41(e). First, the
Commission needs to allow emissions measurements to be made using an RMS (i.e., Root Mean
Square) detector and permit average power measurements, as CTIA requests. This modification
is fully consistent with many other licensed and unlicensed operations covered by FCC rules that

¹ See FCC, Petitions for Reconsideration of Action in Rulemaking Proceeding, GN Docket
reconsideration of the FCC’s 3.5 GHz Report & Order that was released in April. See
Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-
3650 MHz Band, GN Docket No. 12-354, Report and Order and Second Further Notice of
have been in place for decades. Without it, mobile deployments will be forced to operate with substantially less power, which impacts system performance.

Second, Qualcomm supports the CTIA request to relax the out-of-band emissions (“OOBE”) limits on 3.5 GHz CBSDs and End User Devices that would force LTE channels using signal bandwidths greater than 10 MHz to engage in power backoff. The adopted OOBE limits will have a detrimental impact on the utility of the band by requiring mobile devices using 20 MHz (and larger) LTE channels to implement 3 dB (and greater) Additional - Maximum Power Reduction (“A-MPR”) in order to comply. Requiring the transmit power level for 20 MHz LTE operations to be cut in half will significantly diminish signal coverage and overall utility of the band. The FCC should grant the CTIA Petition on this issue and revise the 3.5 GHz band emissions limits as detailed herein to appropriately support channels wider than 10 MHz.

Third, Qualcomm supports CTIA’s request to relax the “additional protection level” requirement limiting emissions below 3530 MHz and above 3720 MHz to be below -40 dBm/MHz, which is needed to support 20 MHz and 40 MHz-wide LTE channels just inside the 3550-3700 MHz band. SIA’s request to move the -40 dBm/MHz protection level inside the 3.5 GHz band should be rejected.

Qualcomm encourages the FCC to promptly address each of these issues, as well as those raised in other Petitions and in the FNPRM, so this band can be put to use to address the looming spectrum crunch without delay.
DISCUSSION

I. The FCC Must Allow Measurements Using An RMS Detector And Should Adjust The 3.5 GHz Emission Limits To Support LTE Channels Greater Than 10 MHz

A. 3.5 GHz Emissions Need To Be Measured With An RMS Detector

Qualcomm strongly supports CTIA’s request to allow emissions measurements to be made using an RMS detector.² The 3.5 GHz Report & Order requires emissions measurements to “be performed with peak detector in maximum hold.”³ Virtually all licensed mobile and unlicensed operations covered by the Commission’s rules, however, allow for average power measurements and use of an RMS (i.e., Root Mean Square) detector.⁴ This same approach should be applied to the 3.5 GHz band. The decision to impose a “peak detector” requirement, which was made without any discussion in the 3.5 GHz Report & Order, will require all forms of LTE (and other technologies) to operate with substantially lower transmit power levels, which negatively impacts signal coverage and system performance.

In fact, the peak-to-average ratio for emissions from LTE signals can easily exceed 10 dB, which means that the measurement requirement imposed in the 3.5 GHz Report & Order could force 3.5 GHz equipment to operate with at least 10 dB less power. This would effectively cripple the band’s ability to support mobile broadband operations.

² See CTIA Petition for Reconsideration at 6-7.
³ See Rule Section 96.41(e)(3)(iv).
⁴ See 47 C.F.R. § 27.50(d)(6) (“Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.”); 47 C.F.R. § 27.50(i) (same); and see 47 C.F.R. § 27.50(b)(11) (“maximum composite transmit power shall be measured over any interval of continuous transmission using instrumentation calibrated in terms of RMS-equivalent voltage. 47 C.F.R. § 27.50(c)(11) (“Licensees may employ equipment operating in compliance with either of the measurement techniques described in paragraph (b)(11) of this section [i.e., an RMS detector] or a Commission-approved average power technique.”). See also 47 C.F.R. § 15.407(a)(4) (“The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.”).
Accordingly, Qualcomm respectfully requests that the FCC grant CTIA’s request and make this change to Rule Section 96.41(e)(3)(iv): “Maximum EIRP and emission power measurements shall be performed with a peak detector in maximum hold over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.” This change is critically important to ensuring the success of 3.5 GHz band mobile operations.

B. The Emissions Limits In The 3.5 GHz Report & Order, Which Were Designed To Support 10 MHz LTE Channels, Would Force Wider Channel LTE Operations To Use Substantially Less Transmit Power

Qualcomm also supports the CTIA Petition for Reconsideration of the emissions limits in rule section 96.41(e)(1)&(2).² The emissions limits that apply outside of the channel of operation were designed around supporting 10 MHz-wide LTE channels, and thus would force 20 MHz LTE and 40 MHz LTE operations to use substantially lower transmit power (than the level 10 MHz LTE operations are permitted to use) and therefore should be revised.

Specifically, the authorized emissions limits that apply outside the channel of operation will require mobile devices operating with 20 MHz LTE channels to implement 3 dB A-MPR and force 40 MHz channelization to implement even greater A-MPR. Such substantial amounts of power backoff, i.e., reducing transmit power by half for 20 MHz LTE and by even more for 40 MHz LTE, will create coverage challenges and limit the band’s ability to support wider bandwidth LTE operations with greater throughput and an improved mobile user experience. This problem applies throughout the entire 3.5 GHz band and impacts both PAL and GAA operations. Thus, it is imperative that the FCC grant the requested relief.

² See CTIA Petition for Reconsideration at 5-6.
1. **Qualcomm Proposes Revised Text To Support Wider-Bandwidth LTE Channels**

In order to enable 20 MHz LTE and 40 MHz LTE mobile broadband operations at the same transmit power levels at which 10 MHz LTE operations are permitted, the FCC should revise Rule Section 96.41(e)(1) to provide 20 MHz LTE operations with an additional 10 MHz on both sides of the operating channel edge (i.e., 20 MHz total) to achieve the -25 dBm/MHz limit and provide 40 MHz LTE operations an additional 30 MHz on both sides of the transmit channel edge (i.e., 40 MHz total) to achieve the -25 dBm/MHz limit. The -13 dBm/MHz limit, which the FCC initially proposed to apply throughout the band, would apply from the channel edge up until the point where the -25 dBm/MHz limit begins, and protect adjacent channel operations within that portion of the band to the same -13 dBm/MHz emissions level that has worked well in other mobile bands, as the FCC acknowledged in the *3.5 GHz Report & Order*.6

Suggested revisions to Rule Section 96.41(e) to implement this change appear below:

(e) **3.5 GHz Emissions and Interference Limits:**

(1) **General protection levels.** Except as otherwise specified below, for channel and frequency assignments made by the SAS to CBSDs, the power of any emission outside the fundamental emission (whether in or outside of the authorized band) for a 10 MHz operating channel shall not exceed -13 dBm/MHz within 0-10 megahertz above the upper SAS-assigned channel edge and within 0-10 megahertz below the lower SAS-assigned channel edge. At all frequencies greater than 10 megahertz above the upper SAS-assigned channel edge and less than 10 MHz below the lower SAS-assigned channel edge for a 10 MHz operating channel, the power of any emission shall not exceed -25 dBm/MHz. For a 20 MHz operating channel, the power of any emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0-20 MHz above the upper SAS-assigned channel edge and within 0-20 MHz below the lower SAS-assigned channel edge; at all frequencies greater than 20 MHz above the upper SAS-assigned channel edge and less than 20 MHz below the lower SAS-assigned channel edge, the power of any emission shall not exceed -25 dBm/MHz. For a 40 MHz operating channel, the power of any emission shall not exceed -13 dBm/MHz within 0-40 MHz above the upper SAS-assigned channel edge and within 0-40 MHz below the lower SAS-assigned channel edge; at all frequencies greater than 40 MHz above the upper SAS-assigned channel edge and less than 40 MHz below the lower SAS-assigned channel edge, the power of any emission shall not exceed -25 dBm/MHz.

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6 *See 3.5 GHz Report & Order* at ¶ 176 (“We proposed applying the long-standing OOB attenuation requirement of 43 + 10 log (P) dB (equivalent to -13 dBm / MHz), to all emissions from CBSDs and End User Devices outside of any channel assigned by the SAS.”).
emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0-40 MHz above the upper SAS-assigned channel edge and within 0-40 MHz below the lower SAS-assigned channel edge; at all frequencies greater than 40 MHz above the upper SAS assigned channel edge and less than 40 MHz below the lower SAS assigned channel edge, the power of any emission shall not exceed -25 dBm/MHz. For operating channels between 10 MHz and 20 MHz and between 20 MHz and 40 MHz, linear interpolation may be used to determine the point of transition from -13 dBm/MHz to -25 dBm/MHz. The upper and lower SAS assigned channel edges are the upper and lower limits of any channel assigned to a CBSD by an SAS, or in the case of multiple contiguous channels, the upper and lower limits of the combined contiguous channels.

These proposed revisions recognize that wider bandwidth transmission channels require a wider roll-off bandwidth and are designed to allow the emissions mask to scale with bandwidth. Qualcomm recommends that the spectrum emissions mask be scaled to the channel bandwidth consistent with the manner in which the mask is defined in 3GPP specifications.

2. **The -40 dBm/MHz Protection Level Is Not Needed Below 3550 MHz**

In addition to the emissions limits discussed above that unduly constrain LTE operations in channel sizes greater than 10 MHz operating anywhere within the 3.5 GHz band, the FCC adopted additional protection levels that apply outside the band edges. In particular, the Commission adopted a very stringent -40 dBm/MHz emissions limit below 3530 MHz and above 3720 MHz — just 20 MHz off of the lower and upper edges of the 3550-3700 MHz band. See 47 C.F.R. § 96.41(e)(2). This requirement will force 20 MHz and 40 MHz LTE operations (both

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7 In 3GPP standards, the boundary between -13 to -25 dBm/MHz emissions level is scaled to bandwidth for single carrier and for contiguous intra-band carrier aggregation. The proposed text follows this convention by allowing interpolation to be used to determine the appropriate point of transition from -13 dBm/MHz to -25 dBm/MHz for operating channels between 10 and 20 MHz and between 20 and 40 MHz.

8 See, e.g., Nokia Petition for Reconsideration at 10-11.
PAL and GAA) just inside the 3.5 GHz band to implement A-MPR — even if the relief
discussed above in Section I.B is adopted — and significantly impact the usefulness of the band.

Imposing such a stringent level just 20 MHz off of the lower band edge is not needed to
protect services in the band below the 3550 MHz band edge. When it considered imposing this
additional -40 dBm/MHz protection level 20 MHz outside the edges of the 3.5 GHz band, the
FCC focused on the C-band earth station receivers that operate above 3702 MHz, just outside the
upper edge of the 3.5 GHz band. With regard to the lower edge of the band, the -13 and
-25 dBm/MHz emissions levels addressed above will protect government radar systems and the
limited Private Land Mobile operations below 3550 MHz. Indeed, the Commission determined
in the 3.5 GHz Report & Order that these emissions levels would adequately protect federal
radar operations adjacent to mobile operations when they are both inside the shared band.
Accordingly, there is no technical need to require additional protection outside the lower edge of
the band, and Qualcomm agrees with CTIA that the FCC should remove the -40 dBm/MHz
additional protection requirement imposed below 3530 MHz.

3. The FCC Should Not Impose A -40 dBm/MHz Emissions Level Inside The Upper Portion Of The 3.5 GHz Band, As SIA Requests

While there is no technical need to provide additional protection of -40 dBm/MHz below
the lower band edge, as explained above, Qualcomm recognizes the concerns raised in the SIA
Petition for Reconsideration relating to the need to protect C-Band earth station receivers
operating above 3702 MHz. SIA’s Petition, however, seeks to overturn the Commission’s

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9 See CTIA Petition for Reconsideration at 6. Should be Commission nonetheless
determine that such a stringent limit is necessary to protect operations below 3550 MHz, the
20 MHz transition gap should be doubled to 40 MHz from the band edge to support 20 MHz
LTE operations and enable 40 MHz LTE operations with less A-MPR. Without this relaxation,
LTE operations using greater than a 10 MHz-wide channel at the lower band edge will need A-
MPR, which as explained above, greatly limits performance and coverage.
decision to expand the 3.5 GHz band to include the 3650-3700 MHz portion, as explained below. The SIA request is completely unnecessary,

The 3.5 GHz Report & Order notes that C-band earth station receivers operating between 3700 and 3720 MHz currently withstand out-of-band emissions at the -13 dBm/MHz level, presumably without any adverse effect. Indeed, the -13 dBm/MHz level that works well in many lower sub-3 GHz frequency bands that support commercial mobile broadband operations also can protect satellite operations above 3700 MHz where signal propagation losses are greater.

SIA nonetheless asks the Commission to impose the -40 dBm/MHz additional protection requirement at 3680 MHz, which is well inside the 3550-3700 MHz band and would prevent any mobile operations from being deployed within the upper portion of the band. SIA believes that such a requirement is needed to protect C-band earth station receivers above 3702 MHz. SIA also claims that the FCC violated the law by setting the -40 dBm/MHz emissions level at 3720 MHz because that requirement was not formally proposed in the NPRM that preceded the 3.5 GHz Report & Order.11

SIA’s Petition seeking reconsideration of this issue fails for several reasons. First, the possible extension of the 3.5 GHz band to include the 3650-3700 MHz portion of the band was under consideration by the Commission since the very beginning of this proceeding, so SIA’s claim that the OOBE rule, which governs emissions outside the upper edge of the band, was adopted without proper notice is misplaced.

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10 See 3.5 GHz Report & Order at ¶¶ 186, 188.
11 See SIA Petition for Reconsideration at 5-6.
Second, as noted above, the FCC’s Part 90 rules currently permit emissions at the -13 dBm/MHz level above 3700 MHz.12 As Qualcomm explained in its comments on the FNPRM, before the FCC considers implementing much more stringent emissions limits, it should verify that satellite receiver blocking is not the actual limiting factor, in which case more stringent OOBE limits will not help and would impose an unnecessary regulatory burden.

Third, SIA’s loss calculations assume all worst case parameters despite the fact that they will not all be present in the overwhelming majority of cases. For example, SIA assumes that CBSDs and End User Devices are transmitting at maximum power, but the FCC’s rules require all 3.5 GHz equipment to implement transmit power control and limit operating power to the minimum necessary to support successful communications. See 47 C.F.R. § 96.41(c). SIA also assumes that C-band earth station receivers are operating at very low elevation angles when only those receivers located in the northernmost regions of the U.S., e.g., Alaska, will operate using such low angles. In addition, small cells located indoors will present much less interference potential to satellite operations.

In sum, there is no question that any harmful interference to C-band operations can be avoided through use of lower transmit power, lower antenna gain, and lower heights by nearby 3.5 GHz mobile equipment and the use of accurate information on the C-band earth station receiver operating parameters. Indeed, it will be critically important to maintain an accurate database of C-band satellite receivers and their specific operating parameters, so the 3.5 GHz SAS can determine the appropriate operating levels for nearby 3.5 GHz CBSDs and End User Devices to avoid causing harmful interference to C-band operations.

12 See 3.5 GHz Report & Order at ¶ 186.
Accordingly, there is no sound technical or legal basis for the FCC to reconsider the additional protection level it imposed above 3720 MHz along the lines requested by SIA. The Commission can and should explore relaxing this protection level along the lines requested by CTIA for the reasons detailed above and in CTIA’s filing.

CONCLUSION

Qualcomm has done extensive work on small cell technology and spectrum sharing with incumbent federal users in the 3.5 GHz band, and we are eager to put this new spectrum band to use. We again applaud the Commission’s sound decision in the 3.5 GHz Report & Order to implement flexible, technology neutral rules in this new band consistent with the FCC’s “longstanding policies promoting technological neutrality and competition in emerging bands” to permit LTE Unlicensed technology within this band and encourage the FCC to promptly address the issues raised in the FNPRM and Petitions for Reconsideration, so that this important band can provide mobile services to consumers in the most timely manner.

Respectfully submitted,

QUALCOMM INCORPORATED


By: 

Dean R. Brenner
Senior Vice President, Government Affairs

John W. Kuzin
Senior Director, Regulatory

1730 Pennsylvania Avenue, N.W.
Suite 850
Washington, D.C. 20006
202.263.0020
Attorneys for QUALCOMM Incorporated

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