

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

In the Matter of

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

GN Docket No. 12-354

REPLY COMMENTS OF QUALCOMM INCORPORATED

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SUMMARY

Virtually all commenting parties agree that it is critically important for the FCC to make the 3.5 GHz band available for mobile broadband use as soon as possible. Mobile broadband data demands are more than doubling each year, and additional spectrum is needed to satisfy these skyrocketing demands so wireless carriers can continue to provide consumers with the best possible user experience in all environments. Because the 3.5 GHz band cannot be completely cleared of federal naval radar systems in a reasonable timeframe, sharing with these incumbent systems is required — particularly near the coastlines where these incumbent systems operate. Qualcomm and its wireless industry partners, who have done extensive small cell development work and are currently trialing small cell deployments at 3.5 GHz, believe the FCC should follow proven, successful means of licensing this band and experiment with ultra-small geographic license areas and ultra-short license terms in another higher-frequency band.

Virtually all commenters agree that the FCC should not adopt the large exclusion zones in the NTIA Fast Track Report that were based upon the deployment of cellular macrocells and exclude 60% of the U.S. population. For this band to be commercially viable, the FCC and NTIA should reassess these zones based upon the use of small cells. Qualcomm showed that small cells can operate on an interference-free basis very close to the U.S. coastlines off of which federal naval radar systems operate, and NTIA recently issued two reports, one of which is based on tests it conducted with Qualcomm, showing that LTE and naval radars may be able co-exist successfully at even closer range.

In addition, the FCC should license the 3.5 GHz band in large geographic blocks, like it has successfully done with other mobile bands. Licensing the band at the census block level — which the agency has never done before — would not only heavily burden licensees' administrative resources, but it would also create potentially overwhelming interference

management challenges at millions of license boundaries. The FCC also should provide ten-year license terms with a renewal expectancy instead of shorter license terms with no renewal rights. This is needed to encourage continued investment and deployment in this band. Otherwise, wireless providers will shy away from this band if they can easily lose the right to operate in a certain area after deploying large collections of small cells.

Furthermore, the FCC has no experience implementing a three tier spectrum access framework with multiple tiers of commercial users each with distinct access rights to the same swath of spectrum when and where incumbent federal users are not operating. The agency is looking to have priority licensed users dynamically share spectrum with incumbent federal radar systems and also allow general authorized access users to access the spectrum when the incumbents and priority licensed users are not operating. As many commenting parties point out, this three tier framework, which has not been implemented anywhere in the world, is particularly complex and will delay deployment in the band for many years. This would be most unwelcome. The FCC should use a simple and proven two tier spectrum access framework that has been fully developed and standardized, and is being used in other countries. Use of a two tier framework and LTE technology will allow this band to be put to use quickly and reliably. Thereafter, the FCC can investigate the introduction of general access users when it is shown that they will not interfere with higher layer licensees, as the FCC's proposed rules require.

In conclusion, Qualcomm and its wireless partners are continuing to develop and field test small cell technology and have standardized a two tier spectrum access framework that will work well in this band. Implementation of a two-tier framework, large geographic area licenses with ten-year terms and a renewal expectancy would be the most timely and reliable means of putting this band to use for mobile broadband connectivity.

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QUALCOMM Incorporated (“Qualcomm”) hereby files these reply comments on the FCC’s *Further Notice of Proposed Rulemaking* relating to the use of small cell technology in the 3.5 GHz band.¹ Qualcomm has done extensive work on spectrum sharing with incumbent federal users and on small cell technology, and we remain optimistic about the possibility of timely deploying these technologies in the 3.5 GHz band. The opening comments make it abundantly clear that many other commenting parties share Qualcomm’s concerns with the FCC’s proposals. If the agency wants to enable the nationwide roll-out of small cell technology in the 3.5 GHz band in a timely and reliable manner, it should not at the outset adopt a completely novel and untested three-tier technical-regulatory spectrum access framework, short term licenses with no right of renewal, and census-tract area licenses that will result in more than one million separate licenses to be administered in this band alone. This band should not be used for such multi-layered experimentation.

¹ See Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket No. 12-354, *Further Notice of Proposed Rulemaking*, FCC 14-49 (Apr. 23, 2014); FCC Public Notice, DA-1071, Wireless Telecommunications Bureau Extends Period To File Reply Comments On Proposed Rules To Establish A Citizens Broadband Radio Service In The 3550-3650 MHz Band, WT Docket No. 12-354 (July 28, 2014).

To put the 3.5 GHz band to use for consumers in a timely manner, Qualcomm strongly recommends that the FCC implement a standardized two-tier spectrum sharing framework and tried and true spectrum licensing means that have worked well in countless other bands, as described herein. This band needs to be made available for mobile broadband use as soon as possible to satisfy consumers' insatiable appetite for robust mobile broadband connectivity.

DISCUSSION

I. The Wireless Industry Is Eager To Put The 3.5 GHz Band To Use As Soon As Possible

The wireless industry and the federal government need to continue working together to completely clear additional spectrum for mobile broadband use and to investigate and capitalize on spectrum sharing opportunities for mobile broadband in bands such as the 3.5 GHz band, which cannot be completely cleared of incumbent federal users in a reasonable time frame. The reason for unleashing vast amounts of additional spectrum is clear: We are in the early stages of a mobile broadband revolution and much more mobile spectrum is needed to support America's exponentially increasing mobile data demands and continued economic growth.

In light of these surging demands, the Commission needs to make the 3.5 GHz band available for mobile broadband use as soon as possible, and Qualcomm and its wireless industry partners have provided the agency with detailed technical information on how to make that a reality. The FCC, however, is proposing rules to govern access to the 3.5 GHz band that Qualcomm fears will delay, and may well derail, the mobile industry's ability to put the band to use. Specifically, in the *FNPRM*, the FCC proposes to simultaneously implement at least four novel and untested spectrum management concepts: (1) Dynamic spectrum sharing with incumbent federal ground-based, airborne, and shipborne radar systems and among two tiers of commercial users, each with distinct spectrum access rights; (2) Implementation of licensed

small cells on a nationwide basis; (3) Licenses with one-year terms, which may be extended for no more than five years total but with no right of renewal; (4) License areas at the U.S. census-tract level, which would result in approximately 74,000 licenses for each specific swath of spectrum, and more than 1 million total licenses for this band along if the entire 3550 to 3700 MHz band is licensed in 10 MHz blocks.

Implementing just one of these novel concepts in a new spectrum band would introduce challenges to deployment, but if the FCC implements all of them in the 3.5 GHz band at the starting gate, it will certainly delay deployment by creating many new and currently unsolved complexities that Qualcomm and others pointed out in their opening comments.² If history holds true, as these complexities are addressed, additional challenges will be encountered and further delay much-needed deployment in this important band.

In comparison, Qualcomm and its industry partners have proposed means of simplifying the FCC's proposals to ensure that the band can be timely put to effective use. The FCC should implement two tiers in the band initially and introduce the third general authorized access tier after it is shown that such operations will not interfere with priority and incumbent users. To encourage investment in this shared band, the FCC also should use traditional licensing means, such as 10 year license terms with a right of renewal, and larger geographic area licenses, such as those used in other licensed mobile bands.

To the extent the Commission wants to experiment in the 3.5 GHz band using untested spectrum management concepts, it should do so in another, higher frequency, band or in a

² See, e.g., AT&T Comments at 19-24; Ericsson Comments; Nokia Solutions and Network US LLC Comments; T-Mobile Comments; Verizon Comments; and see Qualcomm Comments at 4-5.

limited portion of the 3.5 GHz band, as others have recommended.³ Implementing all of these novel concepts in the entire band, as the *FNPRM* proposes to do, will delay deployment and put at risk the ultimate goal of using this band to support mobile broadband connectivity.

A. The Original NTIA Exclusion Zones Should Be Recast As Coordination Zones That Rely On Small Cells And Run A Few Tens Of Kilometers Inland

Virtually every commenting party recognizes that reducing the NTIA Fast Track Report exclusion zones, which cover 60% of the U.S. population, is key to the success of the 3.5 GHz band because the band is not commercially viable if the spectrum is not available in regions of the country where such a huge portion of the U.S. population lives.⁴ The FCC must not implement regulations that adopt the exclusion zones in the NTIA Fast Track Report⁵ because it will cripple the usefulness and value of the band to support mobile broadband.

Qualcomm has shown how the exclusion zones in the NTIA Fast Track Report can be substantially reduced by deploying small cells.⁶ These zones should be recast as coordination zones to enable mobile operations from coast-to-coast where and when federal users are not operating. Indeed, Qualcomm has conducted testing with NTIA to better characterize the impact of radar system interference on LTE performance. NTIA recently released two technical reports

³ See generally AT&T Comments; CTIA Comments; Verizon Comments.

⁴ See, e.g., 4G Americas Comments at 2-4; Alcatel-Lucent Comments at 6-9; American Petroleum Institute Comments at 11; AT&T Comments at 34-39; CTIA Comments at 11-13; Entelec Comments at 6; Ericsson Comments at 10-12; Google Comments at 2-10; Microsoft Comments at 6-9; Motorola Mobility Comments at 12-15; National Cable & Telecommunications Assoc. Comments at 2, 6-8; Nokia Solutions and Network US LLC Comments at 5-9; T-Mobile Comments at 6-8; Telcordia (“iconectiv”) Comments at 6-7; Telecommunications Industry Association Comments at 4-6.

⁵ See *FNPRM*, App. A – Proposed Rule Section 96.15 – Protection of Federal Incumbents; see also *id.* at ¶ 5.

⁶ See Qualcomm February 20, 2013 Comments & Appendix; Qualcomm July 14, 2014 Comments at 7. See also Nokia Solutions and Network US LLC Comments at 7 (noting that the NTIA Fast Track Report did not assess any LTE interface interference management features).

on spectrum sharing in the 3.5 GHz band based on this testing, one showing the impact of the radar interference signal to an LTE system and the other showing the impact of LTE signals on a radar receiver.⁷

The NTIA Reports show that LTE is very robust to radar interference even when LTE is experiencing extreme adverse signal-to-noise ratio conditions and that radar systems can operate successfully in the presence of LTE signals. For example, with a realistic (*i.e.*, bursty) radar signal, LTE can operate without any noticeable impact even when the radar signal level at the LTE receiver is as high as -30 dBm for LTE downlink tests and as high as -25 dBm for LTE uplink tests. Also, the NTIA Report that examined interference to radar systems from LTE shows that so long as the ratio of the interference power received from LTE to the thermal noise floor of the receiver is -6dB (or lower), radar systems can perform well, which is consistent with the assumptions Qualcomm used in its analyses of spectrum sharing in this band. NTIA expects to use these data to update the analyses presented in the NTIA Fast Track Report and substantially decrease the size of the coordination zones.

B. The Authorized Shared Access Two Tier Licensing Framework Can Be Deployed Quickly And Effectively, And Support A Reliable Quality of Service

In order to put the 3.5 GHz band to use for mobile broadband in a timely and effective manner, many commenters agree that the FCC should implement a two tier licensing framework. To the extent the Commission wants to experiment in this band using three tiers of spectrum access, these commenters agree that it should do so in a limited portion of the band (or in a separate band) and extend it throughout the band only after it is shown that the general

⁷ See NTIA Release, New Technical Reports Evaluate Spectrum Sharing in 3.5 GHz Band (July 18, 2014) available at <http://www.ntia.doc.gov/blog/2014/new-technical-reports-evaluate-spectrum-sharing-35-ghz-band>.

authorized access users can reliably “avoid causing harmful interference to Priority Access Licensees and Incumbent Users.”⁸ There is no question that the successful implementation of a three-tier framework will require substantial development, testing and refinement.⁹

On the other hand, a two tier spectrum framework such as ASA can be deployed reliably and much more quickly. As Qualcomm and others have explained, the ASA two tier framework can support coast-to-coast mobile broadband operations via small cells operating on a licensed basis where spectrum is available, as it allows commercial licensees to operate within the interstices of the frequency band where and when government users are not using it, and to quickly vacate the spectrum to allow incumbents to operate when they need to.

The ASA two tier structure also enables a secure interface between federal users and priority license holders to protect sensitive information, such as when and where naval radars are operating (or not operating). Moreover, having a single commercial licensee operate on a given swath of spectrum in a given area makes it much easier to remedy interference concerns, during the initial implementation stage, in the unlikely event any such interference occurs. Moreover, implementation of this two tier framework is completely transparent to the end user device. Operating in the 3.5 GHz band would be just like operating on any other licensed band and does not require any changes to the device or the underlying cellular technology. A multi-band device that supports 3.5 GHz operations would be controlled by a small cell base station that, like a macro cell base station, tells the device when and where it can operate.

⁸ *FNPRM*, App. A – Proposed Rule Section 96.33 – General Authorized Access Use.

⁹ *See generally* 4G Americas Comments at 4-6; Nokia Solutions and Network US LLC Comments; Entelec Comments; Exelon Comments; Iberdrola USA Comments; Verizon Comments.

Most importantly, ASA can be implemented relatively quickly and seamlessly because virtually all of the technical work to enable a two tier framework at 3.5 GHz has been completed. As Qualcomm and others have explained, ETSI is implementing the ASA two tiered framework in Europe.¹⁰ Qualcomm also is working with its wireless industry partners to trial small cell deployments in the U.S. in the 3.5 GHz band. The FCC should use this substantial body of work to help speed deployment of small cell technology in the 3.5 GHz band in the U.S.

C. The Commission Should Implement Well Established Licensing Tools Until It Proves In Multi-Tiered Dynamic Spectrum Sharing Mechanisms

Commenters agree that the *FNPRM* proposes to implement too many novel spectrum licensing concepts in the 3.5 GHz band, such as census-tract level licenses with one-year terms and no right of renewal,¹¹ and they counsel the FCC against adopting them in the 3.5 GHz band.¹² While it is important to explore innovative means of managing spectrum access and licensing spectrum rights, the Commission should not implement these concepts in the 3.5 GHz band because they will create uncertainty and deter investment in this band, will increase the complexity of the spectrum environment in which commercial and federal users are permitted to operate, and will be quite burdensome to administer.¹³ Furthermore, commenters agree with Qualcomm that a census tract licensing regime also “will encourage gamesmanship in the

¹⁰ See generally Ericsson Comments; Nokia Solutions and Network US LLC Comments.

¹¹ See *FNPRM* at ¶¶ 44-52.

¹² See, e.g., AT&T Comments at 25-26; American Petroleum Institute Comments at 9-11; Mobile Future Comments at 1, 5-8; National Cable & Telecommunications Assoc. at 8-10.

¹³ See Qualcomm Comments at 11-12 (describing in detail the many reasons to use conventional licensing means in the 3.5 GHz band). Census tract licensing introduces all sorts of troubling scenarios, e.g., “establishing a licensed small cell network at the Washington Convention Center at the corner of 7th Street and Mount Vernon Place, NW,” in Washington DC, “would require assembling exclusive PALs for at least the six census tracts that intersect there.” Google Comments at 12.

licensing process as prospective licensees will be able to jeopardize system investments by bidding on a limited number of Census Tracts.”¹⁴

The FCC should stick with well-established and proven licensing models in the 3.5 GHz band because mobile broadband operators desperately need to incorporate this spectrum into their networks to continuing meeting consumers’ exponentially increasing data demands. Many commenters agree that 3.5 GHz spectrum rights should be allocated by using the more typical larger geographic areas and 10 year license terms with an expectation of renewal, much like licenses awarded today via auction.¹⁵ In this way, the spectrum may be used reliably for next generation spectrum tools such as carrier aggregation or supplemental downlink to provide the best possible user experience. The Commission could auction channels in areas across the U.S. as it does with traditional mobile licenses, and allow the auction winners to deploy small cells using ASA within the coordination zones and deploy higher-powered macro-cells in inland areas outside the exclusion zones originally identified in the NTIA Fast Track Report.

D. The Commission Should Allow Small Cells To Operate at Low Power Along The Coasts When And Where Federal Incumbents Are Not Operating

Within the areas close to the coast that require coordination with federal incumbent operations, the Commission should allow 3.5 GHz mobile broadband small cells to operate in a cellular configuration with a maximum transmit power of 30 dBm EIRP, which is key to protecting incumbent federal radar systems.¹⁶ Qualcomm supports the FCC allowing the band to be used at higher-power levels for cellular deployments further inland, farther away from the coast as noted above.

¹⁴ American Petroleum Institute Comments at 10.

¹⁵ *See, e.g.*, American Petroleum Institute Comments at 9-11; T-Mobile Comments at 8-11.

¹⁶ *See FNPRM* at ¶ 74.

The Nokia proposal for out-of-band emissions (“OOBE”) in the 3.5 GHz band appears to seek to reuse the 3GPP Band 42 and 43 plans.¹⁷ While this approach is not unreasonable, Qualcomm believes that the better path forward would be to define a new 3GPP band for the 3.5 GHz band because doing so would offer more flexibility for purposes of setting OOBE limits. With regard to the proposals in Paragraph 84 of the *FNPRM*, to the extent the Commission seeks to impose a -40 dBm/MHz OOBE limit, it should not impose a transition gap that is less than 30 MHz below 3550 MHz or 30 MHz above 3650 MHz (or 3700 MHz if the 3650 – 3700 MHz range is also included in the band) due to the increased power back off that would be required of 3.5 GHz user devices in order to comply.

In addition, Qualcomm recommends that the FCC should use a traditional licensing model with static frequency assignments for priority users at the initial stages of implementation because dynamically assigned spectrum allocations add complexity to what will be an already highly complex interference environment.¹⁸

E. The FCC Should Verify That Its Novel Three Tier Framework Works Via Testing In Another Band Before Extending It To The Entire 3.5 GHz Band

Before the Commission implements the proposed three tier framework in the entirety of the 3.5 GHz band, it should take all necessary steps to make sure it works as designed. Given that the third tier general authorized access licensees may not cause any interference to the two higher level tiers, namely the federal incumbents and the priority access licensees, a staged implementation that allows such operations inside the 3.5 GHz band only after they are shown to work as designed in all environments will not delay implementation of priority access licensees via the two tier ASA framework. Requiring that all three tiers operate throughout the entire band

¹⁷ See Nokia Solutions and Network US LLC Comments at 18-19.

¹⁸ See *FNPRM* at ¶¶ 32-34.

at the starting gate, as the *FNPRM* proposes, will certainly delay priority licensed access to the band and impact the usefulness of the band for meeting America's exponentially increasing mobile broadband spectrum needs.

Qualcomm believes that it is critically important to study novel spectrum access concepts and novel spectrum management tools because it can lead to more efficient use of the limited spectrum resource. For the 3.5 GHz band, however, the FCC is proposing to implement too many unproven and untested concepts that will certainly delay deployment of small cells in this band. Access to this band is needed as soon as possible in order to address the mobile broadband data demands. The best path forward is the path outlined herein.

CONCLUSION

The record in this proceeding clearly shows that the wireless industry has done extensive work on small cell technology and on a two tier spectrum access system for sharing spectrum with incumbent federal users, and Qualcomm remains very excited about the possibility of deploying these technologies in the 3.5 GHz band. The FCC should rethink the novel and unproven spectrum access and licensing proposals set out in the *FNPRM* and implement these novel concepts only after they are fully developed and shown to perform well. A two tier spectrum access framework that has been proven to perform well in similar circumstances should be implemented in the meantime along with conventional spectrum licensing mechanisms that have worked well in other bands.

Respectfully submitted,

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