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
	)	
	)	

PETITION FOR RECONSIDERATION BY NOKIA NETWORKS (D/B/A NOKIA SOLUTIONS AND NETWORKS US LLC)

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I. INTRODUCTION

Nokia Networks is the world's specialist in mobile broadband. Innovating at the forefront of each generation of mobile technology, Nokia Networks provides the world's most efficient mobile networks, the intelligence to maximize the performance of these networks, and the services to make it all work seamlessly. Nokia Networks is leading the commercialization of Long Term Evolution (LTE), both its Frequency Division Duplex (FDD) and Time Division Duplex (TDD) versions, in terms of commercial references and live network performance. This includes pioneering efforts in reducing the footprint of mobile base station infrastructure, from compact yet full power macro sites down to the full range of "small cell" solutions.

Nokia Networks continues to believe that the 3.5 GHz band holds the potential to supplement these networks for capacity improvements in particular and applauds the

Commission for releasing its Report and Order[1] establishing rules for Citizens Broadband Radio Service ("CBRS") in the 3550-3700 MHz ("3.5 GHz") band and aimed at enhancing the appeal of the band to expand mobile broadband connectivity to consumers across the nation.

Nonetheless, Nokia Networks is concerned that there are certain technical challenges in the rules that need to be overcome in order to provide a greater degree of certainty for investment in mobile broadband deployments in the band. Nokia Networks therefore asks the Commission to modify certain technical rules as follows:

1. In Part 96.15(b)(4), the suspension and relocation durations should be relaxed from 60 seconds to 10 minutes.

2. In Part 96.41(b), the total transmit power of the Citizens Broadband Radio Service Devices (CBSDs) should be stated simply as maximum Equivalent Isotropically Radiated Power (EIRP) and increased by 6dB for Category A and 9dB for Category B CBSDs respectively.

3. In Part 96.41(e), the Commission should specify emission limits for End User Devices that are compliant with 3GPP specifications to enable the use of existing 3.5GHz Bands 42 & 43 as is in the United States.

4. In Part 96.39, the Commission should set two Vertical Axis location accuracy requirements:

    - One requirement for outdoor installations aligned to the US Government Position Accuracy standard which is <= 15m 95% Vertical Error for Average conditions

[1] Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650MHz Band, GN Docket No. 12-354, "Report and Order and Second Further Notice of Proposed Rulemaking", adopted April 17, 2015, FCC 15-47.

with an allowance of <= 37m 95% Vertical Error for worst site conditions as stated in the Global Positioning System Standard Positioning Service Performance Standard[2].

- One requirement for indoor installations which would be the GPS location of the building for the horizontal location and removing the elevation reporting requirement, allowing for instance, the SAS system to estimate CBSD elevation.

Nokia Networks believes that these technical changes would help enable commercial success while spurring innovation in the 3.5GHz band.

II. NOKIA NETWORKS' ANALYSIS INDICATES A 60 SECOND INCUMBENT DETECTION TO SUSPENSION/ RELOCATION DURATION WILL NOT BE ACHIEVABLE IN MOST LARGE COMMERICAL CBSD DEPLOYMENTS (Rule Part 96.15(b)(4))

Rule Part 96.15(b)(4) states that "*Within 60 seconds after the ESC communicates that it has detected a signal from a federal system in a given area, the SAS must either confirm suspension of the CBSD's operation or its relocation to another unoccupied frequency*."

It is envisioned that a CBRS network management system will use a form of emergency configuration plan change functionality to facilitate CBSDs suspension and relocation in response to an Environmental Sensing Capability (ESC) incumbent detection events relayed via a Spectrum Access System (SAS) and Proxy[3]. The rate at which configuration changes can be propagated to cells is generally proportional to the number of cells requiring reconfiguration. A

[2] *See* http://www.gps.gov/technical/ps/2008-SPS-performance-standard.pdf

[3] *See* FCC 15-47 at Paragraph 230.

Network Management System (NMS) that supports a network of 10,000 cells can require multiples of the existing 60 second duration to complete a configuration change (i.e. suspension or relocation) for all of the network's cells.

It is expected that incumbent radar operations will require the suspension of all CBSDs supported by a single Network Management System. In this case, achieving the goal of a 60 second suspension or relocation time is not expected to be realized. In **Error! Reference source not found.**, an example suspension and relocation duration is presented for a 10,000 cell network with CBSDs supporting 100 cells. In this example, the estimated relocation time exceeds 5 minutes in duration. Therefore, Nokia Networks is recommending that the commission relax the suspension and relocation durations from 60 seconds to 10 minutes.

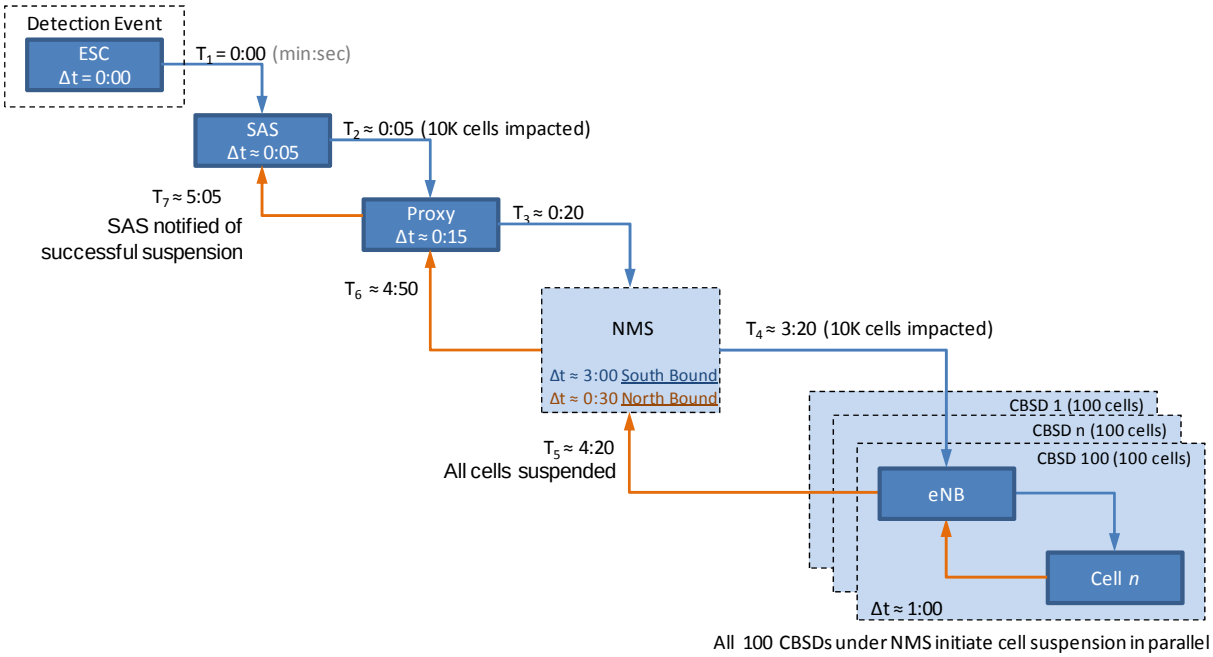
In the case where the Network Management System is bypassed completely and a proxy interfaces directly to CBSD, the 60 second suspension and relocation goals will be a challenge for CBSDs with large numbers of cells.

The primary contributors to delays in suspending or relocating CBSD operation in response to ESC detection of incumbent operation are: SAS detection processing, Proxy suspension request processing, Network Management system suspension request processing, CBSD suspension request processing, Network Management system suspension response processing and Proxy suspension response processing.

Equally dividing the 60 second requirement allocates 10 seconds for each of the processing actions. With the exception of SAS processing, all processing is expected to take longer than 10 seconds to perform in a large commercial CBSD deployment (significantly longer in the case of the Network Management System contribution). This is illustrated with an

example commercial CBSD deployment of 10,000 cells with CBSDs supporting 100 cells in **Error! Reference source not found.**.

Figure 1. Example Suspension and Relocation Processing Delays for 10,000 Cells with CBSDs supporting 100 cells



In the idealized example shown in **Error! Reference source not found.**, we consider 100 CBSDs (each supporting 100 cells) that will act on suspension/relocation requests in parallel when informed by their Proxy/Network Management System. **Error! Reference source not found.** identifies the expected processing delays introduced by the SAS, Proxy, Network Management System and CBSD. **Error! Reference source not found.** also identifies the resulting delay between event detection and the cell suspension/relocation (T_5, 4 minutes 20 seconds), and the delay between event detection and the notification of successful suspension/relocation to the SAS (T_7, 5 minutes 5 seconds). Even in the case where all of the Network Management System's delays are removed, the remaining SAS, Proxy and CBSD delays will continue to exceed the 60 second suspension and relocation requirements by 25 seconds.

III. TOTAL TRANSMIT POWER SHOULD BE STATED SIMPLY AS MAXIMUM EQUIVALENT ISOTROPICALLY RADIATED POWER (EIRP) AND INCREASED BY 6dB FOR CATEGORY A AND 9dB FOR CATEGORY B CBSDs RESPECTIVELY (Rule Part 96.41(b))

Rule Part 96.41(b) gives both the maximum Conducted Output Power and maximum Equivalent Isotropically Radiated Power (EIRP) for CBSDs.

> (b) *Conducted and Emitted Power Limits*: Unless otherwise specified in this subsection, the maximum conducted output power, maximum transmit antenna gain, maximum EIRP, and maximum Power Spectral Density (PSD) of any CBSD and End User Device must comply with the limits shown in the table below:

Device	Geographic Area	Maximum Conducted Output Power (dBm/10 megahertz)**	Maximum EIRP (dBm/10 megahertz)	Maximum Conducted PSD (dBm/MHz)
End User Device	All	n/a	23	n/a
Category A CBSD	All	24	30	14
Category B CBSD*	Non-Rural	24	40	14
Category B CBSD*	Rural	30	47	20

> * Category B CBSDs will only be authorized for use after an ESC is approved and commercially deployed consistent with sections 96.15 and 96.67.

Nokia Networks recommends that the total transmit power specification of the CBSD devices be stated simply as maximum Equivalent Isotropically Radiated Power (EIRP) which is used to compute the total interference contribution. Allocation between conducted power and EIRP would then become implementation specific. It is assumed that the higher antenna gain approach to reach high EIRP values is intended to limit the resulting wide area interference contribution when using Omni pattern antennas, with the assumption that higher gain antennas

will practically be more directional. However, it is possible to deploy Omni coverage with high gain with a larger antenna, which, due to its size, would be deployed at higher installations (i.e. tower, rooftop). This high gain antenna combined with a high installation would result in a more significant interference contribution than a higher conducted power, lower gain antenna, deployed closer to street level. With CBSDs required to provide conducted power and antenna gain information to the SAS, and the SAS having the ability to limit the conducted power from any specific CBSD, it seems to be an unnecessary complication and restriction to specify conducted power and antenna gain separately.

Additionally, for deployments that utilize the CBRS band in a Licensed Assisted Access (LAA) configuration, the operator is likely to deploy the licensed carrier at a more common higher conducted power level (i.e. 37 dBm), with a more practical Omni antenna (i.e. 2 dBi) or directional antenna (i.e. 6 dBi), providing a total EIRP of the licensed carrier from 39 – 43 dBi. Proper operation of the LAA configuration would require the CBRS carrier to have equivalent coverage as the licensed carrier in these specific configurations.

Nokia Networks also views that the maximum Conducted Output Power and EIRP are too low for practical indoor or outdoor deployments. Therefore, we recommend modifying the CBSD transmit power table to Table 1, where only the maximum EIRP values are specified and:

- the maximum EIRP for Category A CBSDs is at least 6dB higher to be consistent with the 2.4GHz ISM and 5GHz U-NII power levels as defined in the Commission's 5GHz Report and Order.[4]

[4] ET Docket No. 13-49, Report and Order, Released April 1 2014, "In the Matter of Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band"

- the maximum EIRP for Category B CBSDs is at least 9dB higher to account for 6 dB to be consistent with unlicensed bands power levels and another 3 dB to account for transmitter diversity for outdoor applications.

Table 1. Nokia's Recommended Transmit Power Requirements to be specified only as EIRP, 6dB higher for Category A CBSDs and 9dB higher for Category B CBSDs

Device	Geographic Area	Maximum EIRP (dBm/10 megahertz)
Category A CBSD	All	36
Category B CBSD	Non-Rural	49
Category B CBSD	Rural	56

If the Commission was to retain the transmit power limits in the Report and Order, we recommend that only the maximum EIRP values are specified as per Table 2 so that the allocation between conducted power and EIRP would then become implementation specific as discussed above.

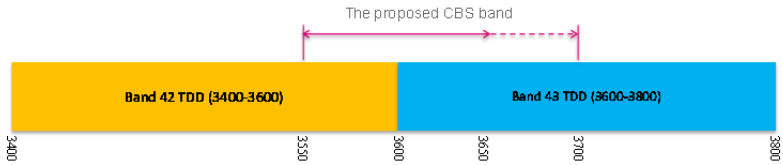
Table 2. Recommended Transmit Power Requirements to be specified only as EIRP in case the Commission keeps the same values as in the Report and Order

Device	Geographic Area	Maximum EIRP (dBm/10 megahertz)
Category A CBSD	All	30
Category B CBSD	Non-Rural	40
Category B CBSD	Rural	47

IV. CONSIDERATIONS REGARDING THE END USER DEVICES EMISSION LIMITS AND GLOBAL ECOSYSTEM (Rule Part 96.41(e))

Band class harmonization helps to achieve economies of scale, enables global roaming, reduces equipment design complexity and improves spectrum efficiency. The existing 3GPP TDD Band 42 (3400-3600MHz) and 43 (3600-3800MHz) would cover the 3.5 GHz band entirely. As illustrated in Figure 2, the first 50 MHz of the CBRS band, 3550-3600MHz, is covered by Band 42 and the remaining 100MHz, 3600-3700MHz, is covered by Band 43.

Figure 2: 3GPP Bands 42 and 43 in relation to the CBRS band.



However, beyond the band plan, the emission limits proposed in the rules should also align with the 3GPP bands 42 and 43 requirements, especially for the End User Devices if we want the United States to leverage the global bands 42 and 43 ecosystems.

Rule Part 96.41(e) proposes that the following Out-of-Band Emission limits to be applied also to End User Devices:

- -13 dBm/MHz from 0 to 10 MHz from the assigned channel edge
- -25 dBm/MHz beyond 10 MHz from the assigned channel edge down to 3530 MHz and up to 3720 MHz
- -40 dBm/MHz below 3530 MHz and above 3720 MHz

If we compare the Commission's emission limits with 3GPP General LTE User Equipment (UE)[5] spectrum mask for a 10MHz channel in Table 3, it can be seen that the Commission's requirements of -13 dBm/MHz from 0 to 10 MHz from the assigned channel edge and -40 dBm/MHz below 3530 MHz and above 3720 MHz are more stringent than the 3GPP specifications. Only the requirement of -25 dBm/MHz beyond 10 MHz from the assigned channel edge down to 3530 MHz and up to 3720 MHz complies with the 3GPP specification.

Table 3. 3GPP General LTE User Equipment (UE) spectrum emission mask

Spectrum emission limit (dBm)/ Channel bandwidth							
Δf_{OOB} (MHz)	**1.4 MHz**	**3.0 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**	**Measurement bandwidth**
± 0-1	-10	-13	-15	-18	-20	-21	30 kHz
± 1-2.5	-10	-10	-10	-10	-10	-10	1 MHz
± 2.5-2.8	-25	-10	-10	-10	-10	-10	1 MHz
± 2.8-5		-10	-10	-10	-10	-10	1 MHz
± 5-6		-25	-13	-13	-13	-13	1 MHz
± 6-10			-25	-13	-13	-13	1 MHz
± 10-15				-25	-13	-13	1 MHz
± 15-20					-25	-13	1 MHz
± 20-25						-25	1 MHz

However, 3GPP also specifies additional spectrum emission requirements which are signaled by the network to indicate that the UE shall meet an additional requirement for a specific deployment scenario as part of the cell handover/broadcast message. For instance, when "NS_03", "NS_11", "NS_20" or "NS_21" is indicated in the cell, the emission limit of any UE emission complies with the levels specified in Table 4.

[5] Equivalent of the Commission's "End User Devices"

Table 4. Additional 3GPP UE emission requirements

	Spectrum emission limit (dBm)/ Channel bandwidth						
Δf_{OOB} (MHz)	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	Measurement bandwidth
± 0-1	-10	-13	-15	-18	-20	-21	30 kHz
± 1-2.5	-13	-13	-13	-13	-13	-13	1 MHz
± 2.5-2.8	-25	-13	-13	-13	-13	-13	1 MHz
± 2.8-5		-13	-13	-13	-13	-13	1 MHz
± 5-6		-25	-13	-13	-13	-13	1 MHz
± 6-10			-25	-13	-13	-13	1 MHz
± 10-15				-25	-13	-13	1 MHz
± 15-20					-25	-13	1 MHz
± 20-25						-25	1 MHz

It can be seen that for a 10MHz channel, -13 dBm/MHz from 0 to 10 MHz from the assigned channel edge can be met except for the first 1MHz offset. However, the emission limit of -40dBm/1MHz at 20MHz offset still cannot be met. To meet -13dBm/1MHz in the first 1MHz offset and -40dBm/1MHz below 3530 MHz and above 3720 MHz may require a new Network Signaling and/or Additional-Maximum Power Reduction to be specified in 3GPP for Bands 42 and 43 to be used in United States.

This analysis would imply that a change in the 3GPP specification is needed for Band 42 and Band 43 UEs to be able to operate under the emission limits proposed by the Commission. We therefore recommend that the Commission defines Out-of-Band Emission limits that complies with the 3GPP specifications and would allow the use of Bands 42 and 43 ecosystem, as is, in the United States.

V. THE COMMISSION SHOULD REVISE ITS ELEVATION ACCURACY REQUIREMENT (Rule Part 96.39)

Nokia recommends that the Commission sets two Vertical Axis location accuracy requirements as discussed below:

- One requirement for outdoor installations aligned to the US Government Position Accuracy standard which is <= 15m 95% Vertical Error for Average conditions with an allowance of <= 37m 95% Vertical Error for worst site conditions as stated in the Global Positioning System Standard Positioning Service Performance Standard[6].

- One requirement for indoor installations which would be the GPS location of the building for the horizontal location and removing the elevation reporting requirement, allowing for instance, the SAS system to estimate CBSD elevation.

OUTDOOR VERTICAL AXIS LOCATION ACCURACY:

Rule Part 96.39 states that "*All CBSDs must be able to determine their geographic coordinates (referenced to the North American Datum of 1983 (NAD83)) to an accuracy of ±50 meters horizontal and ±3 meters of elevation*."

Since the primary method used by many equipment vendors for Outdoor location is Global Positioning System (GPS)-based, Nokia Networks recommends that the requirement for Vertical axis location accuracy be aligned to the US Government Position Accuracy standard which is <= 15m 95% Vertical Error for Average conditions with an allowance of <= 37m 95% Vertical Error for worst site conditions as stated in the Global Positioning System Standard Positioning Service Performance Standard.

[6] [6] *See* http://www.gps.gov/technical/ps/2008-SPS-performance-standard.pdf

Table 4: Position/Time Service Accuracy Standards

3.8.3 SPS Position/Time Service Accuracy Standards

The commitments for maintaining PDOP (Table 3.8-1) and SPS SIS URE accuracy (Table 3.4-1) result in support for position service availability standards as presented in Table 3.8-3.

Table 3.8-3. SPS Position/Time Accuracy Standards

Position/Time Accuracy Standard	Conditions and Constraints
Global Average Position Domain Accuracy • ≤ 9 m 95% Horizontal Error • ≤ 15 m 95% Vertical Error	• Defined for a position/time solution meeting the representative user conditions • Standard based on a measurement interval of 24 hours averaged over all points in the service volume.
Worst Site Position Domain Accuracy • ≤ 17 m 95% Horizontal Error • ≤ 37 m 95% Vertical Error	• Defined for a position/time solution meeting the representative user conditions • Standard based on a measurement interval of 24 hours for any point in the service volume.
Time Transfer Domain Accuracy • ≤ 40 nsec time transfer error 95% of time (SIS only)	• Defined for a time transfer solution meeting the representative user conditions • Standard based on a measurement interval of 24 hours averaged over all points in the service volume.

<u>INDOOR VERTICAL AXIS LOCATION ACCURACY:</u>

Since GPS does not work well or not at all while indoors, Nokia Networks recommends that the requirement for Vertical axis location accuracy for indoor installations be removed, allowing for instance, the SAS system to estimate CBSD elevation. The only requirement for indoor installations would then be the GPS location of the building for the horizontal location.

VI. CONCLUSION

While Nokia Networks is encouraged by the rules in the Report and Order in terms of moving towards enabling the availability of the 3.5 GHz band for use in the provision of mobile

broadband services, we urge the Commission to accept changes in some of the technical rules as follows which we believe would encourage investment and innovation in the 3.5GHz band.

1 In Part 96.15(b)(4), the suspension and relocation durations should be relaxed from 60 seconds to 10 minutes.

2 In Part 96.41(b), the total transmit power of the Citizens Broadband Radio Service Devices (CBSDs) should be stated simply as maximum Equivalent Isotropically Radiated Power (EIRP) and increased by 6dB for Category A and 9dB for Category B CBSDs respectively.

3 In Part 96.41(e), the Commission should specify emission limits for End User Devices that are compliant with 3GPP specifications to enable the use of existing 3.5GHz Bands 42 & 43 as is in the United States.

4 In Part 96.39, the Commission should set two Vertical Axis location accuracy requirements:

- One requirement for outdoor installations aligned to the US Government Position Accuracy standard which is <= 15m 95% Vertical Error for Average conditions with an allowance of <= 37m 95% Vertical Error for worst site conditions as stated in the Global Positioning System Standard Positioning Service Performance Standard[7].

[7] *See* http://www.gps.gov/technical/ps/2008-SPS-performance-standard.pdf

- One requirement for indoor installations which would be the GPS location of the building for the horizontal location and removing the elevation reporting requirement, allowing for instance, the SAS system to estimate CBSD elevation.

We look forward to continuing to work with the Commission and our industry partners to enable the timely deployment of mobile broadband in the 3.5 GHz band.

Respectfully submitted,

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