

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of)
)
Amendment of the Commission's Rules with) GN Docket No. 12-354
Regard to Commercial Operations in the 3550-)
3650 MHz Band)

COMMENTS OF NOKIA SOLUTIONS AND NETWORKS US LLC

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Comments of Nokia Solutions and Networks US LLC

Nokia Solutions and Networks US LLC (“Nokia Solutions and Networks” or “NSN”) hereby responds to the Commission’s *Public Notice* (“PN”)¹ seeking comment on a “Revised Framework” for licensing and technical models in the 3550-3650 MHz (“3.5 GHz”) band. Nokia Solutions and Networks continues to believe that the 3.5 GHz band presents an important opportunity to expand mobile broadband connectivity to consumers across the nation and appreciates the Commission’s efforts aimed at enhancing the appeal of the band for such purposes.

I. INTRODUCTION.

Nokia Solutions and Networks is the world’s specialist in mobile broadband. Innovating at the forefront of each generation of mobile technology, Nokia Solutions and 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 Solutions Networks is leading the commercialization of Long Term Evolution (LTE), both FDD LTE and TD-LTE, in

¹ Commission Seeks Comment on Licensing Models and Technical Requirements in the 3550-3650 MHz Band, GN Docket No. 12-354, *Public Notice*, FCC 13-144 (rel. Nov. 1, 2013) (“Public Notice” or “PN”).

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 Solutions and Networks also offers the industry’s most comprehensive portfolio of services for integrating heterogeneous networks (“HetNets”), encompassing analysis, optimization, deployment and management.

As NSN and our mobile broadband industry peers consistently reiterate, cleared, exclusively licensed spectrum suitable for mobile networks unquestionably remains the top priority, with low band spectrum particularly ideal for wide area coverage. Nokia Solutions and Networks also believes, however, that the 3.5 GHz band holds the potential to supplement these networks for capacity improvements in particular.

Nokia Solutions and Networks applauds the Commission for responding to the significant record already developed in this proceeding. In some important respects, the Revised Framework takes into consideration NSN’s previously offered comments that seek to overcome the unique set of challenges this band presents and provide a greater degree of certainty for investment in small cell deployments. NSN in particular is pleased that the Commission is now proposing to adopt a Priority Access tier that corresponds to NSN’s proposed Authorized Shared Access (ASA)/Licensed Shared Access (LSA) tier that includes Mobile Network Operators. In the comments that follow, NSN offers suggestions on crafting a framework that can best enable commercial success and foster innovative experimentation in the entirety of the 3550-3700 MHz spectrum range.

II. THE COMMISSION SHOULD ALLOW OPEN ELIGIBILITY FOR THE PRIORITY ACCESS TIER AND USE OF PRIORITY ACCESS LICENSES (PALS).

Nokia Solutions and Networks is pleased to see that as suggested by various parties in comments² filed earlier in this proceeding in response to the *NPRM*,³ the Revised Framework would expand the Priority Access (“PA”) tier to a broad class of potential users, including Mobile Network Operators (“MNOs”). NSN agrees that a wide class of users should be able to gain as unfettered access as possible to this spectrum. In particular, we believe that this spectrum holds the potential to play an important role in mobile broadband network architectures. This Revised Framework would essentially add non-critical users with Quality-of-Service (“QoS”) requirements, including MNOs, to the Priority Access tier along with the critical users.

NSN supports the administratively-streamlined licensing of the Priority Access tier via the use of Priority Access Licenses (PALs) to define and control use in the Priority Access Tier. NSN also recommends that individual PAL licensees have contiguous blocks of spectrum that can be aggregated together.

However, NSN has concerns about the proposal to utilize one year, non-renewable license terms, even with the possibility for licensees to aggregate multiple consecutive PALs to obtain multi-year rights to spectrum within a given geographic area. NSN believes that a one year term will be insufficient to provide the predictability and certainty needed for MNOs and other potential PA users of the spectrum to make investments in the band. The Commission has already developed a simplified “lightly licensed” regime in 3650-3700MHz with licenses that

² See, e.g., Verizon Reply Comments in GN Docket No. 12-354 at 4; NSN Comments at 12-18; Qualcomm Comments at 5-11; CTIA Comments at 12-16.

³ See Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket No. 12-354, *Notice of Proposed Rulemaking*, 27 FCC Rcd 15594 (2012).

run 10 years. NSN therefore recommends that the Commission consider, at a minimum, making available similar 10-year terms for the new 3550-3650MHz band while keeping the PN's proposed administratively-streamlined licensing of the Priority Access tier via the PALs. Even if the Commission ultimately views 10 years as too long, NSN believes that terms significantly more than a single year are warranted.

Similarly, we support using license areas that are larger than census tracts, even if census tracts can be aggregated into larger areas. The administrative burden of managing some 74,000 census tracts is one issue, as is the fact that the tracts are not stable and can vary significantly in geographic size. Moreover, for MNOs and others likely to deploy in larger geographic areas and in many locations, it presents a model strongly divorced from typical network rollouts and adds an undesirable and unnecessary level of complexity. NSN at this time is not proposing specific license area sizes but is confident that entities likely to seek licenses will do so.

The PN also proposes 10 MHz unpaired channels as a standard PAL bandwidth. While NSN ideally would prefer bandwidths wider than 10 MHz in order to practically deploy high data rate mobile broadband technologies, the unpaired 10 MHz block has several benefits, namely:

1. 10 MHz channels would scale evenly into 100 or 150 MHz blocks depending on the amount of spectrum allocated at 3.5 GHz (3550-3650 MHz or 3550-3700 MHz).

The incumbent uses of these two sub-bands differ as follows. 3550-3650 MHz incumbent users include Federal government users such as Department of Defense ("DoD") radars and non-Federal Fixed Satellite Services (FSS). 3650-

3700 MHz is used extensively by Wireless Internet Service Providers (“WISPs”), among others, on a non-exclusive basis, to provide commercial broadband service with protections for incumbent non-Federal FSS operations. The 3650-3700 MHz band is allocated for primary use by the federal Radiolocation Service (RLS) at three designated sites.

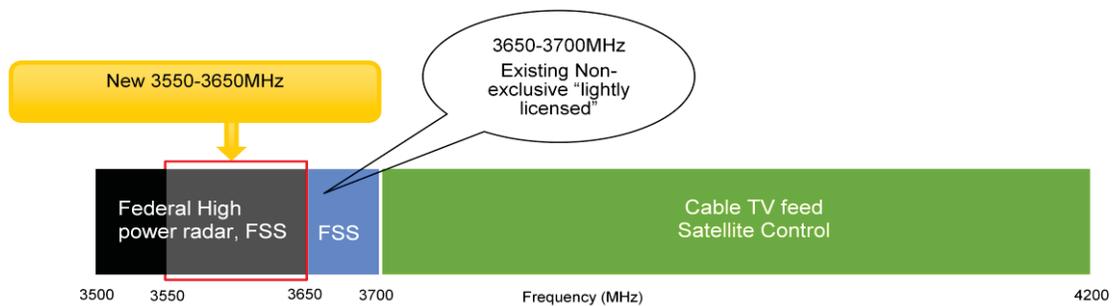


Figure 1: 3550-3700MHz band

2. 10 MHz channels would provide for multiple Priority Access users in a single area.
3. 10 MHz would be a useful building block for licensees that wish to aggregate larger amounts of spectrum.
4. More importantly, it would allow the use of existing global 3GPP Long Term Evolution (LTE) Time Division Duplex (TDD) Bands 42 and 43, harmonizing with the rest of the world.⁴

- TDD Band 42: 3400-3600 MHz

⁴ See 4G Americas White Paper, “*Meeting the 1000x Challenge: The Need for Spectrum, Technology and Policy Innovations*,” October 2013, available at http://www.4gamericas.org/documents/2013_4G%20Americas%20Meeting%20the%201000x%20Challenge%2010%204%2013_FINAL.pdf.

- TDD Band 43: 3600-3800 MHz

In general, it is preferable if new spectrum is covered by an existing band to avoid having to create a new one in 3GPP. The Commission adopting TDD is the right way forward to create an ecosystem for the 3.5 GHz band. Band class harmonization helps to achieve economies of scale, enables global roaming, reduces equipment design complexity and improves spectrum efficiency. Indeed, with the Commission adopting TDD, the existing 3GPP Band 42 and 43 would cover the 3.5 GHz Citizens Broadband Service (CBS) band entirely. As illustrated in Figure 2, the first 50 MHz of the Commission’s CBS band, 3550-3600, is covered by Band 42 and the second 50 MHz, 3600-3650, is covered by Band 43. Note that if the FCC decided to extend the CBS band up to 3700 MHz, Band 43 will still cover the extended portion. It would seem that a TDD band plan is more flexible and accommodating than a FDD band plan, especially if the FCC were to expand the CBS band beyond 3550-3650 MHz in the future.

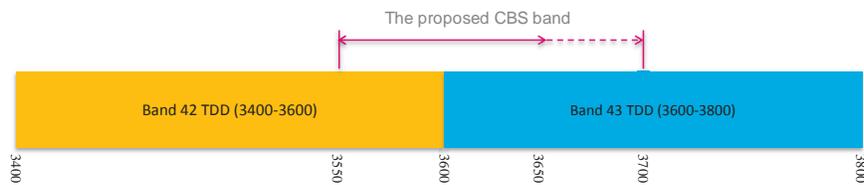


Figure 2: 3GPP Bands 42 and 43 in relation to the CBS band.

NSN also continues to agree with the Commission that the combination of the propagation characteristics of this spectrum range and the inevitable limitations on its use due to incumbent users make small cell use of the band a likely attractive proposition. The Commission however should not enact into its regulations such a preference. For example, there may turn out

to be interest in deploying higher powered systems in areas away from incumbent users, including rural settings. A hallmark of good spectrum policy in recent years is allowing for flexible use and maintaining technology neutrality and that should apply here as well. In Section III, we discuss how to possibly allow such flexible use in the band.

III. NSN RECOMMENDS A BAND PLAN THAT ALLOCATES PRIORITY ACCESS USE TO 3550-3650 MHZ AND GAA USE TO 3650-3700 MHZ.

The PN seeks comment on a band plan that balances Spectrum Access System (SAS)-enabled General Authorized Access (GAA) use with Priority Access (PA) exclusive use. We believe that to best address this situation, the Commission should take a holistic view and also consider the following questions in the PN collectively:

- Would a GAA “floor” in each area encourage widespread GAA deployment and operation and should that floor be a minimum of, e.g., 40 or 50 percent of available bandwidth?
- Whether and how the Revised Framework could be extended to the 3650-3700 MHz band and if special provisions would need to be made for incumbent operators?
- Should Critical Users (e.g., hospitals) receive interference protections within a limited portion (e.g., 20MHz) of the spectrum inside the confines of their facilities? The PN further seeks comment on whether such use would require special RF shielding around eligible facilities to provide interference protection. (¶¶36-38)

In addition, the Commission should also consider the fact that the 3.5 GHz band will likely be the first band where sharing with incumbent Federal government users such as Department of Defense (DoD) radars will be required on a large scale and that, therefore, the Commission should take the necessary steps to ensure that the sharing in this band is a success,

meaning that both the incumbents and the Citizens Broadband Service users can use the band to fulfill their missions while providing “adequate interference protection for Federal users, especially users with national security, law enforcement, and safety-of-life responsibilities.”⁵ If the sharing in this band is successful, 3.5 GHz could pave the way for other federal government bands to be opened for commercial use in a shared manner. The Commission should therefore consider a simplified framework for sharing while still providing spectrum for Priority Access and GAA users.

There are potentially four categories of users that need to share the spectrum:

1. Incumbents such as high powered Department of Defense (DoD) radars and non-federal Fixed Satellite Service (FSS) earth stations.
2. Priority Access Critical users such as hospitals, utilities, etc.
3. Priority Access Non-Critical users such as Mobile Network Operators.
4. GAA users.

In addition to sharing spectrum among these 4 categories of users, each category will have multiple users that need to coexist (e.g., multiple hospitals, multiple operators, etc). The GAA users would be authorized to use the 3.5 GHz Band opportunistically within designated geographic areas and have to always accept harmful interference from incumbents and Priority Access users, meaning there is no guarantee for a minimum Quality-of-Service. On the other hand, the incumbents and Priority Access users are entitled to interference protection which should provide a guarantee of a minimum Quality-of-Service.

⁵ See The White House Office of the Press Secretary, President Obama’s “*Memorandum for the Heads of Executive Departments and Agencies*,” June 14, 2013.

1. Mitigating interference among Priority Access (PA) Users or between PA and GAA Users.

Managing these four categories of users while ensuring that incumbent users can be protected will be complex. There are various ways of mitigating interference among the multiple PA users or between PA and GAA users such as separating the users in time, geography or frequency and/or providing shielding around eligible buildings. For instance, the PN further seeks comment on whether special RF shielding around eligible Critical Users facilities such as hospitals would provide interference protection. While this measure might be possible, there is a cost associated with shielding or upgrading buildings. In addition, there can still be some residual interference through windows, *etc.* One of the best ways of mitigating interference, therefore, is to separate the users in the frequency domain. A possibility NSN recommends the Commission considers is the following:

- Allocate GAA use only in the 3650-3700MHz band.

This would provide GAA users with 50 MHz of contiguous spectrum. It would align with the Commission's goals of allocating a minimum amount of spectrum to GAA users in all markets and including the existing 3650-3700 MHz band in the Revised Framework. Within 3650-3700 MHz, GAA users could be afforded access to contiguous blocks of spectrum that can be aggregated.

In addition, existing or new non-exclusive licensees in 3650-3700 MHz could continue to operate under the current regulatory framework governing that band⁶ but

⁶ See 47 C.F.R. Part 90 Subpart Z; Wireless Operations in the 3650-3700 MHz Band, ET Docket No. 04-151, *Report and Order and Memorandum Opinion and Order*, 20 FCC Rcd 6502 (2005) (*3650-3700 MHz Report and Order and Memorandum Opinion and Order*).

requiring interference protection from GAA users. This would provide certainty and avoid transition cost to the 3650-3700 MHz licensees if they were to transition to the new Citizens Broadband Service regime. In addition, the 3650-3700 MHz licensees could still have Priority Access to 3550-3650 MHz through the Priority Access Licenses (PALs). The 3650-3700 MHz licensees would benefit from the new ecosystem that is likely to develop with 3GPP TDD band 43 that covers 3600-3800 MHz. Economies of scale could drive down the price of equipment for current 3650-3700 MHz licensees and future licensees, making it more affordable for new and existing operators to expand their service offerings. The main incumbents in 3650-3700 MHz are Fixed Satellite Service (FSS) earth stations. When the Commission authorized the shared use of 3650-3700 MHz it adopted 150 km exclusion zone around grandfathered FSS earth stations but also allowed licensees in 3650-3700 MHz to negotiate with individual FSS earth station licensees for smaller exclusion zones. An exclusion zone can similarly be used to protect the incumbent FSS earth stations from GAA users without the use of the Spectrum Access System (SAS). Its size will need to be determined based on further study. However, the SAS could be used in 3650-3700 MHz to enable spectrum sharing between the non exclusive licensees and GAA users. Having GAA users restricted to 3650-3700MHz would also mitigate any interference risks from GAA users to Federal Government users in 3550-3650MHz.



Figure 3: 3650-3700MHz, 2-Tier Non-Exclusive Licensees/GAA users managed by SAS

- Allocate only Priority Access Users, not GAA users, to 3550-3650MHz.

Allocating a minimum amount of spectrum to GAA use in 3550-3650 MHz potentially would mean less spectrum available for Priority Access use in 3550-3650 MHz. For instance, if 40% of the bandwidth is allocated to GAA, only 60MHz is available to Priority Access users in 3550-3650MHz. This will need to be shared between critical users (*e.g.*, hospitals) and non critical users (*e.g.*, MNOs) at a given location. In addition, when the incumbents are using the spectrum, there can be restrictions on the use of the spectrum by the PA licensees. Further, with TDD operation, some level of coordination is necessary to avoid the use of guard bands between different operators/users on adjacent PALs. Critical Users (*e.g.*, hospitals) could also be allocated a specific 20 MHz of spectrum inside the confines of their facilities. With critical users

confined within their facilities, there is a higher probability that this 20 MHz of spectrum could be reused by different critical users because of the isolation provided by the buildings, separation distances between the critical users, *etc.* However, there could still be interference from and to non-critical users like MNOs which have deployed their systems just outside of those buildings. This can be particularly true for dense urban areas where a hospital could be located just off a street where operators have deployed small cells on lamp posts, *etc.* In those cases, the operators might not be able to use the 20 MHz that the hospital is using and therefore only the remaining 80 MHz would be available to the non-critical operators. This is still larger than a 40% GAA/60 % PA split in 3550-3650 MHz.

For all of these reasons, the spectrum available to PALs should be maximized. The best way to do this is to not allocate any GAA use in 3550-3650 MHz. NSN anticipates that in this model which provides more certainty, essentially all of the PALs will be used and there is no need for the SAS to automatically make that spectrum available for GAA use locally. Should this prediction not prove true, the Commission could revisit at a future time whether to allow GAA use in this portion of the band. Taking this approach would provide 100 MHz of contiguous spectrum for PALs, allowing for the possibility of multiple licensees having access to significant amounts of spectrum. NSN also recommends that individual PAL licensees get contiguous blocks of spectrum that they can aggregate together.

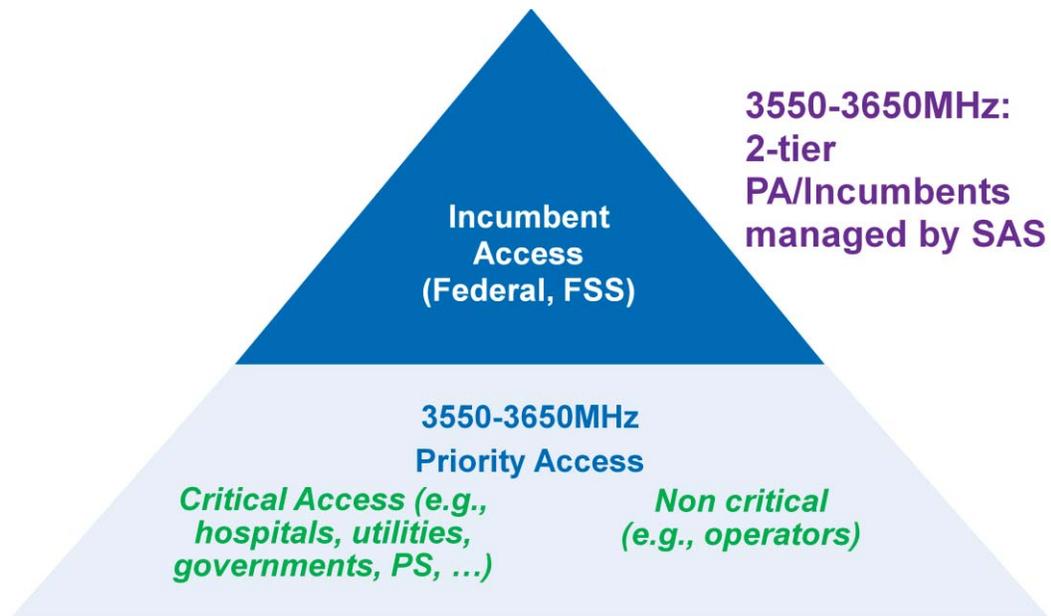


Figure 4: 3550-3650MHz, 2-Tier Incumbents/Priority Access users managed by SAS, no GAA

NSN therefore offers its vision for a Revised Framework as shown in Figure 5 for consideration by the Commission that would help achieve the Commission’s goals of allowing “productive” use of the spectrum while protecting the PA users and Incumbents:

- Expand PA tier to include non-critical users like MNOs in 3550-3650 MHz. Manage incumbents/PA by theSAS.Allow GAA use in 3650-3700 MHz and afford non-exclusive licensees higher priority than GAA. Manage non-exclusive licensees/GAA by the SAS.

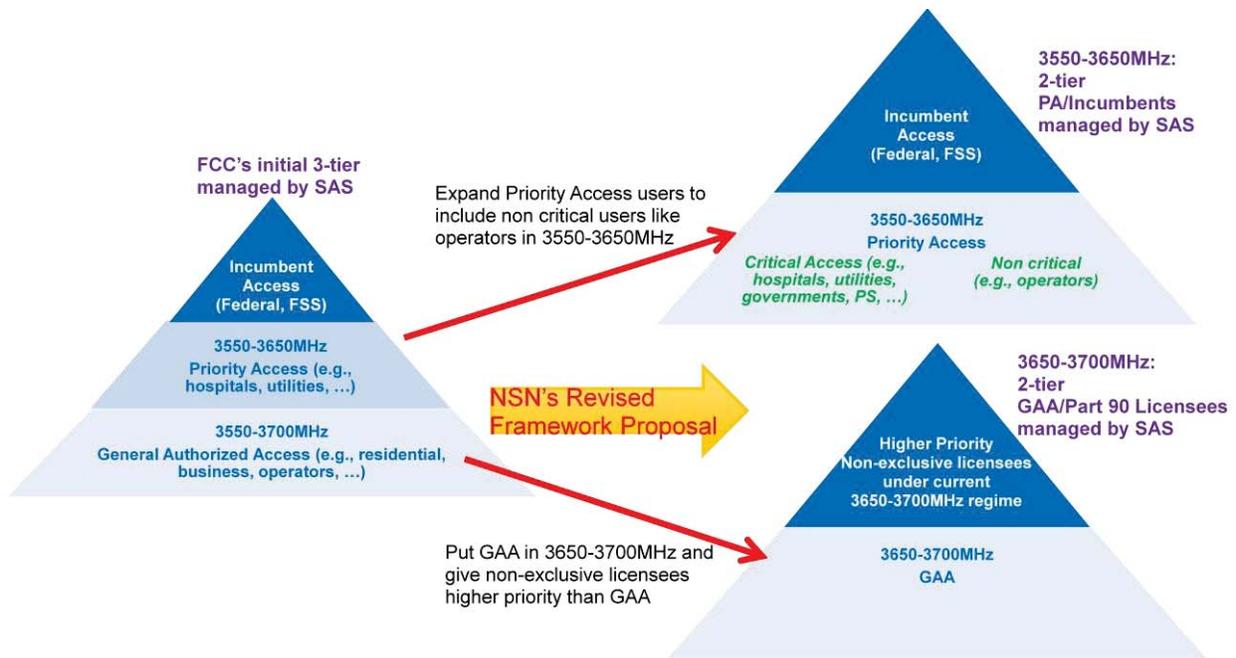


Figure 5: NSN's Revised Framework Proposal

IV. CONSIDERATIONS REGARDING TRANSMIT POWER AND THE SPECTRUM ACCESS SYSTEM (SAS).

As expressed above, NSN is pleased that the Commission proposes to adopt a Priority Access (PA) tier that corresponds to NSN's proposed Authorized/Licensed Shared Access (ASA/LSA) tier that includes Mobile Network Operators (MNOs).⁷

While the SAS is addressed more directly in a separate recent Commission Public Notice,⁸ NSN nonetheless believes that it is appropriate to discuss here some important elements of the SAS, a critical component of the whole regulatory framework for 3550-3650 MHz. The PN anticipates that many of the potential network parameters and RF configurations of systems operating in the 3.5 GHz band will be managed by the SAS. NSN refutes this notion, especially

⁷ See Nokia Solutions and Networks comments in GN Docket No. 12-354 "Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550- 3650 MHz Band."

⁸ Wireless Telecommunications Bureau and Office of Engineering and Technology Call for Papers on the Proposed Spectrum Access System for the 3.5 GHz Band, GN Docket No. 12-354, *Public Notice*, FCC DA 13-2213 (rel. Nov. 18, 2013).

for the Priority Access spectrum in 3550-3650 MHz. NSN's view is that the SAS should only identify the available spectrum to authorize use in a particular location/frequency/time, perhaps enhanced with technical requirements such as the interference threshold that should not be exceeded in a given geographical area where the incumbent is operating. The SAS essentially should have the role of the ASA/LSA Repository that NSN presented in its comments on the 3.5 GHz NPRM as shown in Figure 6 below.⁹ There could be one or more repositories. The ASA Repository may be directly managed by the regulator or the incumbent, or be delegated to a trusted third party.

The external SAS should not configure and/or set limits on various radio parameters to maximize efficient use of the band. This configuration should be left to the Priority Access users, especially MNOs, through the use of a Controller similar to the one that NSN presented as part of its ASA/LSA¹⁰ proposal that could be used in 3550-3650 MHz to manage spectrum sharing between Federal incumbents and Priority Access users. The reasons why NSN recommends that a Controller function sitting inside a PA network and not the external SAS configures the network parameters include:

- Such configuration process requires deep insights into the PA licensee's radio access network.
- Such configuration requires access to information that is business sensitive for the PA licensee.

⁹ See Nokia Solutions and Networks comments in GN Docket No. 12-354 "Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550- 3650 MHz Band"

¹⁰ *Id.*

- There are many parameters to be configured taking into account the entire network layout and interactions of Base Stations (BSs), which is best managed by the network operator.
- The PA network operator must have control to optimize traffic in its network.
- There is a real danger of “mis-configuration” from an external entity like the SAS.
- There are various internal elements to a network that an external SAS cannot and should not oversee.

However, the PA licensee should be responsible for compliance with technical requirements obtained from the SAS such as meeting certain interference thresholds. This can be accomplished via the Controller under the full control of the PA network operator.

The ASA/LSA/PA Controller manages the access to the spectrum made available to the ASA/LSA/PA licensee based on rules built upon ASA/LSA/PA rights of use and information on the incumbent’s use provided by the Repository or SAS. It retrieves information about available shared spectrum from the SAS or Repository through a secure and reliable communication path and propagates the permission or prohibition of use of the shared spectrum to the radio access network (RAN). There could be one or multiple ASA/LSA/PA Controllers for each ASA/LSA/PA licensee. The Controller can interface with one or multiple ASA/LSA/PA Repositories. On a more technical view the ASA/LSA/PA controller uses the information from the SAS or repository to provide parameters to the Priority Access licensee’s network (e.g., the MNO in Figure 6).

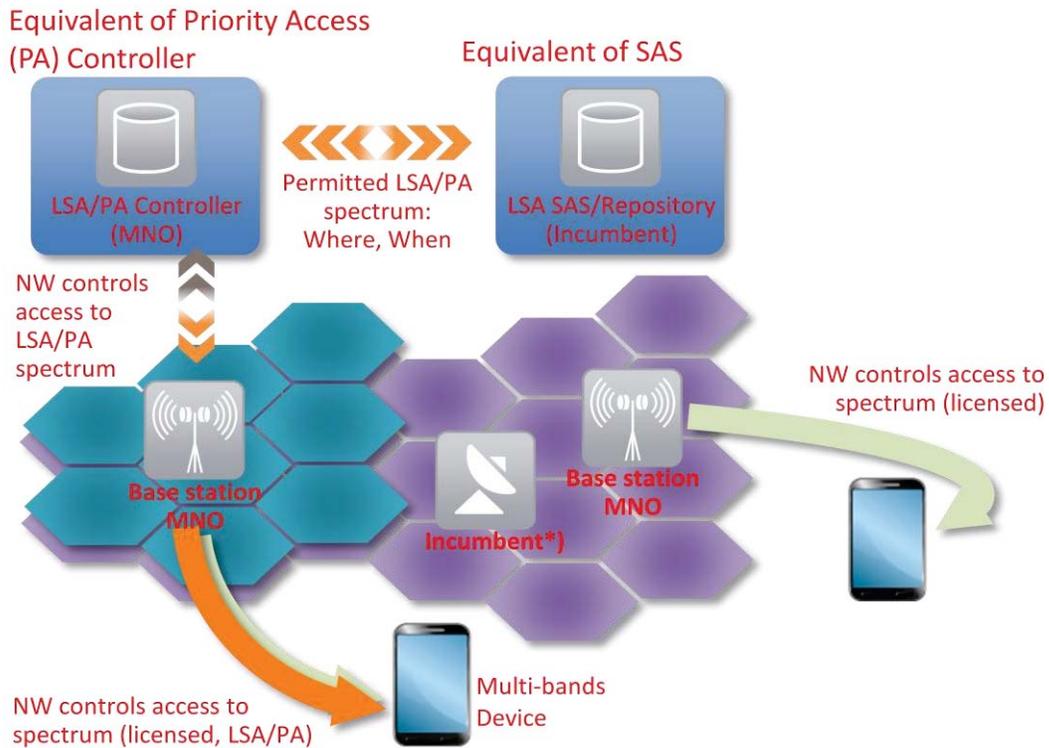


Figure 6: Example of ASA/LSA/PA architecture.

NSN also recommends that the Commission not place any restriction on Base Station Transmit Power so as to allow maximum flexibility of the spectrum. For instance, in areas where there are no incumbent operations, the user should be allowed to transmit at higher power. This can help extend the range of the network and improve connection quality.

User devices should follow the 3GPP TS 36.101 standards including the allowed tolerance, *i.e.*, a maximum transmit power of 25dBm for 3.5 GHz bands 42 and 43.¹¹ LTE technology uses very sophisticated Transmit Power Control to adjust the transmit power of the LTE devices and prevent interference, ensuring effective spectrum sharing.

¹¹ See 3GPP TS 36.101 V12.1.0 (2013-09), “User Equipment (UE) radio transmission and reception (Release 12).”

EUTRA band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 4 (dBm)	Tolerance (dB)
42					23	+2/-3		
43					23	+2/-3		

Table 1: 3GPP LTE UE Power Class for 3.5GHz TDD bands 42 and 43

Minimum receiver standards for the systems likely to operate in this band should follow technical specifications of standards bodies such as 3GPP.¹² The Commission should not specify minimum receiver standards.

V. CONCLUSION.

Nokia Solutions and Networks is encouraged by the progress reflected in the Public Notice in terms of moving towards enabling the availability of the 3.5 GHz band for use in the provision of mobile broadband services. While cleared, exclusively licensed spectrum remains the top priority for the commercial wireless industry, the 3.5 GHz band has some unique characteristics that promise to make licensed sharing a viable and interesting proposition in this particular instance.

NSN strongly supports the Revised Framework’s proposal to provide open access to a Priority Access (PA) tier for any entity interested in operating in a quality-of-service environment, including importantly mobile network operators that are feeling the effects of constantly escalating consumer demand for improved mobile broadband speeds and coverage. Such a PA tier functionally is equivalent to NSN’s proposed ASA/LSA tier. Allowing only PA in the 3550-3650MHz band would maximize the number of PA licenses that can then serve the needs of both critical and non-critical licensees while ensuring that the incumbent Federal users are protected. Additionally, NSN supports expanding the Revised Framework to include 3650-3700 MHz to make a total of 150 MHz available and enable essentially a 50 MHz “sand box” for

¹² *Id.*

GAA use in 3650-3700 MHz while providing higher priority status and protection to current and future licensees that operate in this band under Part 90, Subpart Z. NSN believes that these measures as a whole would provide the right combination to enable commercial success and foster innovative experimentation in the entirety of the 3550-3700 MHz spectrum range. Depending upon how utilization of the band develops and matures in the coming years, the Commission of course could revisit at a future time whether to allow GAA use within 3550-3650 MHz or make other adjustments to the framework.

Respectfully submitted,

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