Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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

To: The Commission

COMMENTS OF TARANA WIRELESS

Tarana Wireless hereby submits comments in response to the Commission's Further Notice of Proposed Rulemaking ("FNPRM") in the above-referenced proceeding.[1]

Introduction

Tarana Wireless has pioneered the development of AbsoluteAir, the world's only Universal Backhaul solution that meets operator's requirements for metropolitan small cell backhaul deployments and fixed wireless access. It provides the flexibility and simplicity of deploying wireless backhaul anywhere small cells are located without compromising capacity or link reliability. Built from the ground up as a carrier class product, this breakthrough innovation combines ubiquitous coverage, unprecedented capacity and scalability, and unparalleled cost effectiveness in both *Non-Line-of-Sight* (NLoS) and *Line-of-Sight* (LoS) installations that cannot be met by any other offering.

[1] 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, (rel. April 23, 2014) ("FNPRM").

RESPONSE ON INCORPORATING AN ADDITIONAL 50MHz TO THE NPRM

We applaud the Commission's efforts to make additional spectrum available to address the exponential growth in wireless network capacity demand, and we encourage opening up the additional spectrum in the 3550 – 3650 MHz band. However, **Tarana strongly opposes the Commission's proposal to extend the considered regulations to include the 3650-3700 MHz band**, the reasons outlined below in paragraphs 1-6. Tarana also provides reply comments and proposed additions/modifications to the proposed rules in the 3550 – 3650 MHz band to further promote improved spectral efficiency and economic viability of the band. They are provided in paragraphs 7-10.

1) **The existing regulations in the 3650 – 3700 MHz band are effective:** Given severe interference potential in the 3550 – 3650 MHz, and the number of incumbent federal operations that need to be protected, an innovative but complex licensing scheme like the one proposed is necessary. However, potential for interference in the 3650 – 3700 MHz is far less, allowing effective sharing under the existing regulatory framework, without the additional restrictions, licensing complications and additional cost incurred by switching to a new set of rules.
2) **The 3650 – 3700 MHz band is important for NLOS Backhaul.** Small cell deployment will play an increasing role in the deployment of wireless infrastructure. To that end, opening up 100MHz of additional access capacity in the 3550 – 3650 MHz provide much needed additional spectrum. But large-scale small cells deployments can only happen if cost-effective backhaul solutions are available. With backhaul costs representing the lion share of

operator's small-cell deployment CAPEX, large-scale small cell deployments hinge on a cost-effective backhaul alternative. In many cases, this cost-effective solution is NLOS backhaul. The 3650 – 3700 MHz represents a very important band for NLOS backhaul, especially since there are few other bands usable for this application in US. A strong ecosystem of equipment providers was formed - including Tarana Wireless - and these providers have developed highly-innovative, high-capacity backhaul solutions in this band, with major carriers planning to deploy it at scale. A change in the regulations for this band would make such equipment obsolete, and would hurt and delay small cell deployment. Finally, the experimental nature of newly proposed regulation, and the associated risks of poor performance or additional subsequent regulatory changes constitutes a strong deterrent for any large-scale backhaul deployment in the band.

3) **NLOS technologies in the 3650-3700 MHz feature very high spectral efficiency.** Given that NLOS backhaul technologies are generally not following a particular standard at the PHY layer, there is a large potential for innovation. The introduction of advanced antenna-array processing, beam-forming and interference cancellation technology, NLOS backhaul systems feature spectral efficiency that are much larger than the ones achievable today in access systems. For example, the Tarana Wireless AA2 system achieves a spectral efficiency of 60bps/Hz, much higher than any access system. This allows backhaul systems deployed in very little spectrum to backhaul access deployed over much wider channels. Maintaining existing regulation in the 3655-3670 MHz band will allow the deployment of such systems, which will make for an optimized use of the band.

4) **SAS model great for access, backhaul needs to be always on.** While the adoption of a SAS-based licensing model may be adequate for a range of access systems, the SLA

requirements are very different for backhaul systems, which need to be highly available and reliable, essentially always-on. This is not achievable in the SAS model.

5) **A change in regulation will hurt incumbents, but also new entrants in the band.** Changing regulations to the 3650-3700 MHz can hurt incumbents who, even if grandfathered over a period of 5 year, will need to reduce the emitted power levels of their deployed equipment in accordance to new regulation. But it will hurt even more the mobile operators planning to deploy NLOS backhaul for small cells in the near future. For these new deployments, the reduction in allowable EIRP will limit range and capacity of backhaul systems – essential in this application, while the short licensing periods and the large number of licensing areas will make the use of the band much less attractive and practical.

6) **Large investment to date, financial hardship, loss of business:** At the time Tarana Wireless commenced developing its AbsoluteAir line of products in 2011, and in years to follow, discussion with a number of mobile operations revealed that the 3650 – 3700 MHz band was a prime candidate for large-scale deployments of cost-effective NLoS backhaul for small cells. The original PCAST recommendations bolstered this business case, with the promise of freeing up an additional 100MHz spectrum for small cells. Given this, Tarana Wireless has decided to invest millions of dollars and years of research and development in order to build a NLoS backhaul system in this band. The result of these activities, Tarana's AA2 product line, is scheduled to launch commercially at the end of 2014, and positioned for immediate large-scale deployment with a number of customers. A change in the 3650 – 3700 MHz regulation would result in significant loss of business, with most prospective customers re-evaluating their plans of using 3650 – 3700 MHz band for backhaul. Even if backhaul in

this band will remain a possibility, implementing the necessary equipment changes would introduce years of additional delay and millions in additional expenditures.

7) **Multiple Point to Point for Backhaul.** Tarana seeks to clarify the rules for point to point to systems operating in the 3550 -3650 MHz. Point to point systems will be primarily used for small cell backhaul in this band. Common deployment scenarios consider that small cells will be deployed with 2 to 4 small cells per sector of a macro cell (3 sectors). The small cell backhaul will typically terminate at a fiber point to presence – typically available at a macro-cell site. In this use case, multiple point to point radios will terminate at the macro cell or fibre point of presence. Tanana seeks to clarify that each link may operate with a conducted power (30 dBm) and EIRP (53 dBmi) as described in section 96.38 (b) of the proposed rules**.** We note the each link carries independent information and narrow antenna beam pattern do not overlap (no significant power summation) because the backhaul seeks minimize interlink interference.

8) **FCC Innovative Rules to Improve Spectral Efficiency Reused in the 3550 to 3650 MHz band.** In part §15.247, Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz, the FCC adopted rules to promote improved spectral efficiency in this proceeding. Tarana recommends similar rules for the 3550 to 3650 MHz band to promote improved spectral efficiency and lower interference at the seams of the Service Areas defined by the 74,000 Census Tracts. Our recommendations are as follows:

   a) Fixed, point-to-point operation and multiple point-to-point operations, excludes the use of multiplexed point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information.

b) Transmitters operating in the band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following. Different information must be transmitted to each receiver. If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, *i.e.*, the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows: The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

c) A lower value for the directional gain than that calculated in paragraph (b) will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming due to multipath or other environment effects.

d) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in section 96.38 (b) of the proposed rules. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limits. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in section 96.38 (b) of the proposed rules by more than 8 dB.

9) **Phase in the strict out of band emission limits.** Tarana supports the rule that emissions limits below 3520 MHz and above 3680 MHz shall be attenuated below the transmitter power (P) in watts by at least 70 + 10 log10(P) dB. However, these limits require technologies such as low cost FBAR filters or low cost custom SAW filters. Due to the experimental nature of this band, uncertainty exists. The design and fabrication of filters require very large investments to produce filters that can be manufactured at low cost. Filter vendors are not going to make the capital investment without market size visibility of millions of units. Due to the experiment nature of the band, it is not certain that market will develop in a robust fashion. Accordingly, Tarana recommends a phase in of this requirement. It is estimated that PALs can be auctioned within one year, first article equipment with standard filters available in year 2, custom RF filters designed, fab and tested within year 3 (given credible use of the band indicating that volume can be achieved), and compliant equipment available in year 4. Accordingly, Tarana recommends full compliance with the 70 +10 log10(P) dB requirement after 5 years from adoption. Until then, 43 +10 log10(P) dB should be the requirement. We believe this will encourage the rapid adoption of the band and ultimately serve the public with the benefits of superior out of band emissions once volumes are confirmed in this band.

10) **TDD Time Synchronization promotes better spectral efficiency.** The 3.55 to 3.65 GHz band is a TDD band by design and regulation. It is well known, that if the CBSD and end user devices are synchronized in time that interference is minimized between in-cell users and inter-cell users. This in a fundamental requirement in TD-LTE. Accordingly, Tarana proposes to coordinate and minimize in band, adjacent census tract, and adjacent band interference by standardizing on the TD-LTE frame structure. This standard provides several well know frame formats and configurations. Moreover, by proposing a standards-based frame structure, the FCC can

minimize the interference discontinuities at the edges of the Service Areas defined by the Census Tracts. To wit, there are 74,000 Census Tracts x 10 bands of 10 MHz each. The number of Census Tracts Bands is over 740,000. The prospect for increased spectral efficiency is just staggering through coordination of the TDD timing.

Respectfully submitted,

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