Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
Use of Spectrum Bands Above 24 GHz For	)	GN Docket No. 14-177
Mobile Radio Services	)	

To: The Commission

COMMENTS OF SIBEAM, INC.

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COMMENTS OF SIBEAM, INC.

SiBEAM hereby submits its comments in GN Docket No. 14-177 in response to the Commission's Notice of Inquiry NOI 14-154 regarding the use of spectrum bands above 24 GHz for mobile radio services. We appreciate the opportunity to provide these comments to the FCC.

I. INTRODUCTION

SiBEAM is an industry leader in developing millimeter wave (mmW) technologies for consumer, telecommunications, and wireless infrastructure applications. SiBEAM was the first company to ship a commercial 60 GHz phased array based chipset solution for the consumer electronic market in 2008 (http://www.businesswire.com/news/home/20080106005115/en/SiBEAM-Announces-Availability-Worlds-WirelessHD-TM-Chipset#.VLaVont1kVQ). Since then, newly developed SiBEAM technology and products in the 60 GHz band span various standards, applications, and markets, with some of the products highlighted below. SiBEAM is a wholly owned subsidiary of Silicon Image and some of the links below point to Silicon Image's website.

Consumer electronics market:

WirelessHD chipsets – World's first 60GHz connectivity standard supporting Full HD video up to 1080p60 with near-zero latency (less than 5ms) for real-time content sharing between devices. http://www.siliconimage.com/60ghz_wirelesshd

UltraGig 6400 – Specifically designed for smartphones and tablets, this ultra-low power transmitter enables robust high-definition wireless video connectivity between portable devices and large displays, delivering a cable-quality connection without wires. http://www.siliconimage.com/solutions/wireless

SiBEAM Snap – Wireless connector technology designed to replace any USB 2.0 or USB 3.0 connector. http://www.sibeaminc.com/company/press-releases/sibeam-announces-revolutionary-snap-wireless-connector-technology

Telecommunications / Infrastructure market:

SiI6340 / Sii6342 - Single-chip 60GHz beam-steering RF transceivers address key design considerations for the small cell wireless backhaul market. http://www.siliconimage.com/solutions/wireless_backhaul/

II. 60 GHz Band (57-64 GHz and 64-71 GHz)

In the NOI, the Commission seeks comment on the advisability of amending the rules to allow unlicensed Part 15 operations in the 64-71 GHz band segment and requests to provide supporting information on existing or in development viable technology that would be envisioned for this band. SiBEAM strongly supports extending the current unlicensed Part 15 operation for the 57-64 GHz band (the "lower 60 GHz band") to the "upper 60 GHz band" from 64-71 GHz. This will create 14 GHz of contiguous spectrum with harmonized regulations which we believe will significantly accelerate growth of existing and new applications in this band.

An important application that we believe will be empowered by this rule change is a multi-gigabit, large scale, dynamically switches wireless network equivalent to current fiber metro networks. Such a wireless switched network can enable and drive significant expansion in broadband connectivity for many applications

- Provide backhaul for mobile 4G LTE small cells and/or metro-WiFi nodes
- Serve as the backbone connectivity for future 5G networks with mixed-mode backhaul and access connectivity
- Enable cost effective extension of fiber optic networks to the end users
- Expand high speed broadband connectivity options to areas currently underserved by Cable/DSL/or Fiber

The requirements for building such a network are

a. Wireless links supporting multi-gigabit throughput with low latency

b. Low cost and low power electrically-steered phased arrays with wide steering angle to allow the design of wireless mesh nodes which have 360° view

c. Wide contiguous spectrum availability to allow frequency diversity in a dense mesh deployment

SiBEAM has already demonstrated a mass production 60 GHz phased-array radio transceiver which has 32 antenna elements in a single, fully integrated CMOS chip. The system based on this radio transceiver achieves 4 Gbps data throughput using a 1.76 GHz wide channel compliant with the IEEE 802.11ad channelization for the 60 GHz frequency band. Using the 802.11ad channelization, there are three independent 1.76 GHz frequency channels in the 57-64 GHz band to allow a low density wireless mesh deployment. SiBEAM is currently designing a system to demonstrate such a wireless mesh network deployment. The concept system shown

in Figure 1 uses the SiI6340 or SiI6342 radio transceivers which have 120° scanning angle in a 3-face configuration to enable the full 360° view for each wireless mesh node. A similar concept system is shown in Figure 2 with a 4-face configuration better suited for the urban grid layout.

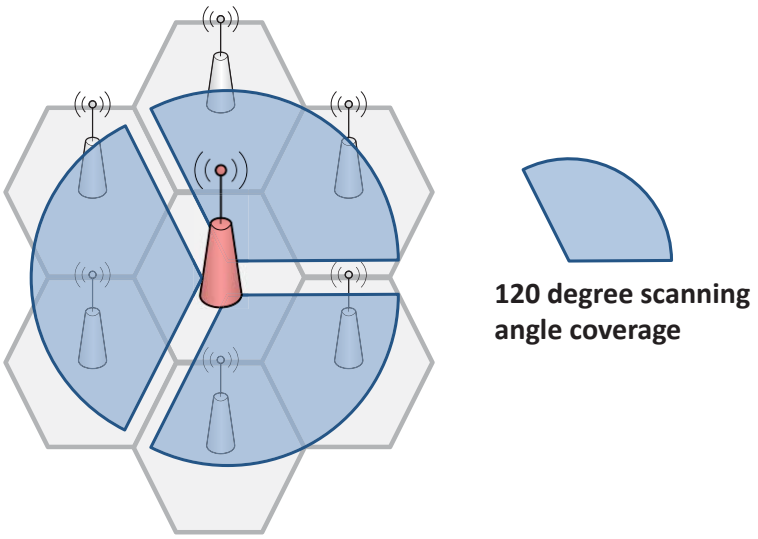

Figure 1: Concept 60 GHz mesh node with three faces for a full 360° view

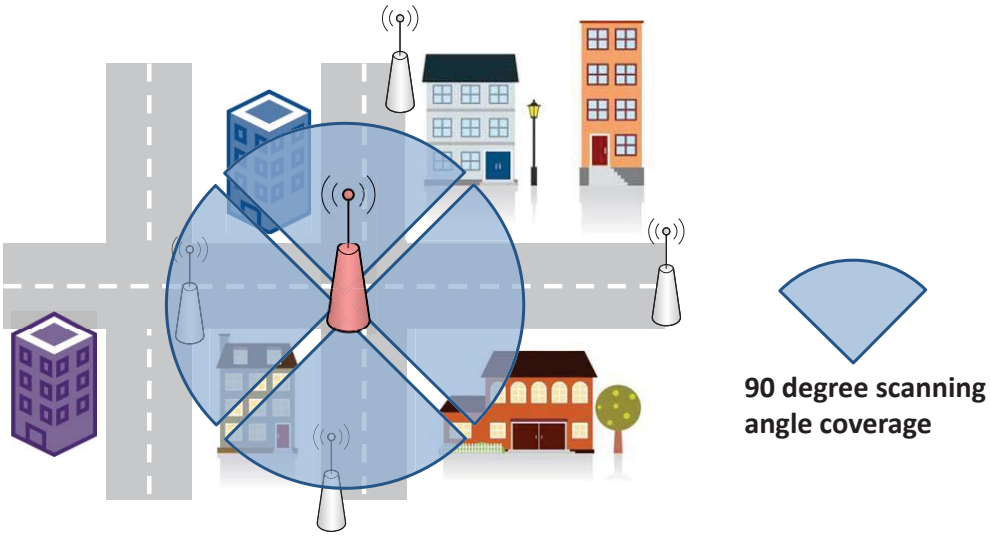

Figure 2: Concept 60 GHz mesh node with four faces for a full 360° view

Adding the upper 60 GHz band from 64-71 GHz to the available 60 GHz spectrum will add three more independent frequency channels for a total of six channels and allow a high density wireless mesh deployment. Alternatively, using 2X channel bonding it would be possible to create 10+ Gbps wireless mesh networks and still have three independent channels to allow the deployment of a dense mesh. A high density and high capacity wireless mesh is needed to support the high data throughput envisioned for 5G mobile services.

Furthermore, looking at the atmospheric attenuation in Figure 3, the oxygen absorption peak at 60 GHz is very narrow. An RF channel centered at 60.0 GHz will see 15 dB/km loss, while an RF channel centered above 68 GHz will see less than 1 dB/km loss. That means that a 60 GHz link that is nominally designed to operate up to 500m in the lower 60 GHz band, will be able to operate at about 1000m if switched to use the upper 60 GHz band channels. Having such flexibility in the wireless mesh network deployment can significantly reduce the cost and speed-up the deployment of such networks especially in lower density sub-urban and rural areas.

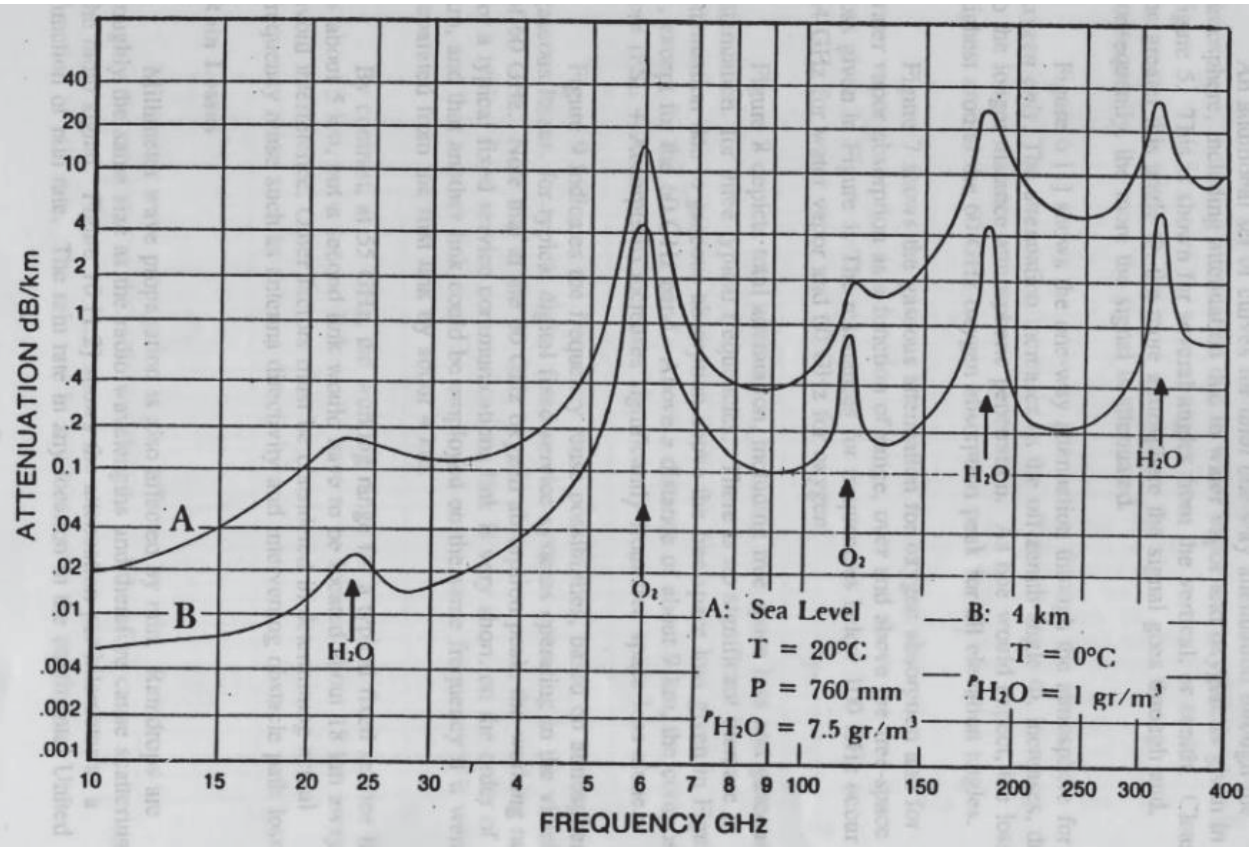

Figure 3: Atmospheric attenuation loss [FCC OET Bulletin Number 70]

III. 70/80 GHz Bands (71-76 GHz and 81-86 GHz)

In the NOI, the Commission seeks comment on the advisability of allowing unlicensed Part 15 operation in the 70/80 GHz band segments. The existing 70/80 GHz regulations and licensing model was designed for Fixed Service systems with narrow “pencil-beam” point-to-point coverage only. Since the original 70/80 GHz regulations, new services (mobile access), new antenna technologies (phased array and dynamic beam forming), and new wireless network topologies (mesh) that support dynamically reconfigurable links are being actively developed.

SiBEAM believes that there is a need to modify and adapt the regulations to the current market needs.

In our system analysis we find that it is practically impossible to meet the FCC 50 dBi and 43 dBi 70/80 GHz RPE requirements in the 70/80 GHz E band using state-of-the-art electronic beam steering systems. This prevents 70/80 GHz systems to benefit from any technology advancements done on fully integrated electronically-steered phased-array systems in the 60 GHz band. The benefits that electronically-steered phased-array systems can provide are especially important for the long range, high throughput, high reliability links that are normally deployed in the 70/80 GHz bands:

- Auto-alignment of the links during installation using electronically-steered phased-array to reduce the cost and increase the speed of link deployments
- Active electronic beam tracking to compensate for wind sway during link operation to increase link reliability
- Wireless electronic link switching to increase fault tolerance and allow dynamic network reconfiguration

SiBEAM encourages the Commission to revisit the 70/80 GHz band rules and lower the minimum antenna gain requirements and the RPE requirements to support the implementation of 70/80 GHz links using practical phased array antennas with wide beam steering range. We also encourage the Commission to revisit the 70/80 GHz licensing model to include the ability to license 70/80 GHz links with phased-array antennas which can be reconfigured dynamically. This can be done by allowing a multi-link license, a wide coverage beam license, an area license or something similar.

IV. Conclusion

SiBEAM appreciates the Commission's consideration of its comments and welcomes any questions concerning its technologies, development work in this area, and the submitted material.

Respectfully submitted,

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