

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)	
)	
Spectrum Horizons)	ET Docket No. 18-21
)	
)	

COMMENTS OF SIERRA NEVADA CORPORATION

Sierra Nevada Corporation (“SNC”) hereby responds to the Federal Communications Commission’s (“FCC” or “Commission”) proposal to authorize service rules for operations above 95 GHz.^{1/} SNC has requested that the Commission initiate a rulemaking proceeding to allow Part 87 radionavigation radars to operate in the 92-95.5 GHz frequency range for Enhanced Flight Vision Systems (“EFVS”).^{2/} SNC provides comment, in particular, on the use of the 95-100 GHz frequency band.

I. BACKGROUND AND INTEREST OF SIERRA NEVADA CORPORATION

Sierra Nevada Corporation, established in 1963 and headquartered in Sparks, Nevada, is a privately owned and operated company focused on aerospace, aviation, system integration, and electronics. SNC has numerous fielded systems operating throughout the world by both private and public entities, and it won the contract to develop the Dream Chaser spaceplane that will deliver cargo to the International Space Station.

^{1/} *Spectrum Horizons; Battelle Memorial Institute Petition for Rulemaking to Adopt Fixed Service Rules in the 102-109.5 GHz Band; Request for Waiver of ZenFi Networks, Inc. and Geneva Communications LLC; James Edwin Whedbee Petition for Rulemaking to Allow Unlicensed Operation in the 95-1,000 GHz Band*, Notice of Proposed Rulemaking and Order, GN Docket No. 18-21, FCC 18-17 (rel. Feb. 28, 2018) (“NPRM”).

^{2/} *Amendment of the Commission’s Rules to Allow for Enhanced Flight Vision System Radar under Part 87*, Petition of Sierra Nevada Corporation for Rulemaking, Docket No. RM-11799 (filed Feb. 16, 2018) (“SNC Petition”).

For nearly a decade, SNC has been developing a radar-based EFVS that would allow for landings of fixed and rotary wing aircraft during Degraded Visual Environments (“DVEs”), such as brownouts, sandstorms, snowstorms, and other poor visibility conditions.^{3/} On February 16, 2018, SNC filed a Petition for Rulemaking (“Petition”) requesting that the Commission modify Part 87 of its rules to allow EFVS radar operations in the 92-95.5 GHz frequency range.

There are no commercial solutions that allow for aircraft landings in moderate to severe DVE conditions.^{4/} Current EFVS technologies on the market, which are based on infrared camera sensors, have proven to be inadequate because the infrared wavelengths are near the visible spectrum. Adding mmWave radar redresses this problem, allowing pilots to “see” through heavily degraded visual conditions. The FAA has determined that providing pilots with this capacity “should increase access, efficiency, and throughput at many airports when low visibility is a factor.”^{5/} Presently, “[i]nterrupted flight operations due to low visibility result[s] in lost passenger time and extra fuel consumption.”^{6/}

SNC chose the 90 GHz frequency range for short range EFVS radar for several reasons. From a physical perspective, 90 GHz is the optimal frequency range to maximize obscurant penetration and radar angular resolution. Adding mmWave radar provides for the best overall

^{3/} As noted in the NPRM, SNC is one of the parties that has received an experimental license to test its EFVS system in the 92-95.5 GHz frequency range. NPRM at n. 162.

^{4/} SNC Petition at 2.

^{5/} Federal Aviation Administration, *Revisions to Operational Requirements for the Use of Enhanced Flight Vision Systems (EFVS) and to Pilot Compartment View Requirements for Vision Systems*, Final Rule, 81 Fed. Reg. 90126 (Dec. 13, 2016). The FAA, which regulates aircraft airworthiness and operations, has issued rules and guidances on when and how EFVS may be used during approach operations. *See* 14 C.F.R. § 95.175 (instrument flight landing requirements) and Federal Aviation Administration, *Enhanced Flight Vision Systems*, Advisory Circular 90-106A (Mar. 2, 2017).

^{6/} *See* Federal Aviation Administration, *Revisions to Operational Requirements for the Use of Enhanced Flight Vision Systems (EFVS) and to Pilot Compartment View Requirements for Vision Systems*, Notice of Proposed Rulemaking, 78 Fed. Reg. 34935, 34949 (June 11, 2013).

technological solution to achieving deep penetration with moderate resolution in nearly all visual obscurants. Other frequency ranges are less optimal. For example, a lower frequency range often used by traditional radar systems (*e.g.*, the X-band, approximately 10 GHz) allows for very deep penetration, but resolution would be an order of magnitude worse, and could not be used to resolve runways and other objects at required ranges.

Permitting 90 GHz radar for EFVS will allow for numerous public benefits, including:

- Supporting the goals of the FAA’s NextGen Implementation Plan, which seeks to improve aircraft approaches and landings, as well as other flight operations;^{7/}
- Providing access to a greater number of airports and runways when visibility is low;^{8/}
- Eliminating airport ground infrastructure used for landings and approaches, which is costly to deploy and maintain;
- Decreasing the number of redirected and/or delayed flights, thereby improving airport efficiencies and reducing aircraft operational costs;^{9/} and
- Improving the environmental impact of flights by reducing the use of fuel when aircraft are kept in holding patterns or need to be rerouted, and potentially limiting flights over environmentally sensitive areas.^{10/}

Given the many public benefits that would be achieved through the adoption of SNC’s proposed rules, SNC urges the Commission to consider future use of the 95-100 GHz band in this proceeding in conjunction with the rule changes being proposed by SNC.

II. DISCUSSION

The time is ripe for the Commission to begin facilitating the deployment of technologies above 95 GHz. SNC’s experimental testing of short range radar confirms the ability of industry to make use of at least the lower portion of the spectrum horizons frequencies. Therefore, SNC supports the Commission’s tentative conclusion that it is in the public interest to promote the

^{7/} Federal Aviation Administration, *NextGen Implementation Plan 2016*, at 38-41 (2016), available at https://www.faa.gov/nextgen/media/NextGen_Implementation_Plan-2016.pdf.

^{8/} *Id.* at 39.

^{9/} *Id.*

^{10/} *Id.*

development of bands above 95 GHz.^{11/} As the Commission rightly observes, atmospheric loss, free space propagation losses, and the use of very narrow antenna beams will allow for the establishment of less complicated spectrum sharing arrangements.^{12/}

The Commission states that it seeks to provide a regulatory framework that balances “the specificity needed to encourage further investment and the generality required for spectrum bands whose potential use is largely undefined at this time.”^{13/} SNC agrees with this approach. Other types of licensed services besides Fixed Services will be developed for frequencies above 95 GHz, and the Commission should be cautious that it does not hamper technological development and enhancement by foreclosing the sharing of spectrum by various types of technologies.^{14/}

The Commission seeks comment about frequency bands that have shared allocations with radar use, including 95-100 GHz, asking whether these allocations will be used in the future by non-federal radar.^{15/} The Commission further asks how fixed and/or mobile stations may share spectrum with radar services, seeking comment on the use of certain spectrum sharing arrangements such as geographic separation, reliance on databases, or the use of radar sensing technologies.^{16/}

One important consideration is the commercial production of chipsets and key components for high resolution imaging radars that the Commission may expect to be used in the U.S.,

^{11/} NPRM at ¶ 20.

^{12/} *See id.* at ¶¶ 24-25.

^{13/} *Id.* at ¶ 27.

^{14/} *Cf* Letter from Brennan Price, Hughes Network Systems, LLC to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-21 (filed March 9, 2018) (requesting that the FCC defer action on sharing rules between fixed satellite service and fixed wireless until technologies are further developed because “predetermining sharing rules before there is a technology to effectively use these bands may discourage its development.”).

^{15/} NPRM at ¶ 50.

^{16/} *Id.*

including for EFVS.^{17/} These technologies have coalesced around the 92-96 GHz range, generally designed to operate with a center frequency at 94 GHz and bandwidths of up to 4 GHz, equating to an average frequency range of 92-96 GHz. The SNC radar in particular operates with a center frequency of 94 GHz and an operational frequency range of 92.5-95.5 GHz.^{18/}

In terms of spectrum sharing between short range radar and fixed and/or mobile services, the spectrum characteristics of 90 GHz facilitate the Commission allowing sharing among multiple users. Radio frequency signals in millimeter wave bands “suffer from severe propagation losses.”^{19/} For example, “a 0.65 kilometer path at 92 GHz produces the same loss as a 10 kilometer path at 6 GHz, namely, 128 dB.”^{20/} Beams in 90 GHz are so narrow that multiple users can operate very close together in the same area without causing interference to one another. These characteristics facilitate spectrum sharing between radar and fixed and mobile services, as transmission interference is more localized. One option for spectrum sharing in the 95-100 GHz band suggested by SNC in its Petition is recording the locations where radar operations will occur, such as by registering flight landing patterns in databased maintained by spectrum managers. SNC believes that requiring fixed or mobile devices to have radar sensing capabilities would be unnecessary.

^{17/} Key components for high resolution radar include power amplifiers (for transmitters) and low noise amplifiers (for receivers) specifically matching the frequencies of operation.

^{18/} Standard chipsets and components suitable for high resolution imaging radars are not commercially available for radar operations below 92 GHz or above 96 GHz.

^{19/} *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, GN Docket No. 14-177, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, 32 FCC Rcd 10988, ¶ 85 (2017) (referring to 64-71 GHz).

^{20/} *Allocation and Service Rules for the 71-76 GHz, 81-86 GHz and 92-95 GHz Bands*, Report and Order, 18 FCC Rcd 23318, ¶ 45 (2003). These characteristics allow systems to be “engineered in close proximity to other systems.” *Id.*

III. CONCLUSION

The 90 GHz band is uniquely well suited for short range radar systems that can penetrate degraded visual environments. Industry chip and parts manufacturers have coalesced design of their technologies centered around 92-96 GHz, almost all using a center frequency of 94 GHz. Given the state of this available equipment and technology, as well as SNC's requested rule change, the FCC should assure that deployment of EFVS radionavigation in 95-95.5 GHz may occur in conjunction with any new fixed or mobile services allowed within this frequency range.

Respectfully submitted,

/s/

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May 2, 2018