Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Advancing Understanding of Non-Federal Spectrum Usage	)	WT Docket No. 23-232
	)	
	)	

COMMENTS OF THE GPS INNOVATION ALLIANCE

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The GPS Innovation Alliance ("GPSIA") respectfully submits these comments in response to the *Notice of Inquiry* ("*NOI*") in the above-captioned proceeding.[1] The premise of this proceeding is to advance the Commission's understanding of non-Federal use of spectrum, including through an assessment of how the Commission should define "spectrum usage," whether there are band-specific considerations, and how to measure and access data that will better allow the Commission to improve spectrum management. GPSIA encourages the Commission, in examining tools that may be used to determine spectrum usage, to consider the unique characteristics of the U.S. Global Positioning System ("GPS") and refrain from taking any action that would inadvertently jeopardize its use.

I. INTRODUCTION AND SUMMARY

GPSIA was formed to protect, promote, and enhance the use of GPS and Global Navigation Satellite System ("GNSS") technologies. GPS/GNSS receivers are used in myriad government, military, commercial, public safety, food security, and critical infrastructure applications. GPSIA members and affiliates are drawn from a broad cross-section of the economy and represent a wide variety of fields and businesses whose billions of consumers are

[1] *See Advancing Understanding of Non-Federal Spectrum usage*, Notice of Inquiry, FCC 23-63 (rel. Aug. 4, 2023) ("*NOI*").

reliant on GPS in U.S. and non-U.S. markets. GPSIA includes organizations in the manufacturing, aviation, agriculture, construction, transportation, emergency response, surveying, mapping, and defense industries and organizations. They represent consumers who depend on GPS for boating and other outdoor activities, and in their automobiles, farm vehicles, smart phones, and tablets. GPS is a highly innovative, successful, and ubiquitous technology that has injected $1.7 trillion into the nation's economy[2] and is critical to the smart infrastructure, services, and applications of today, tomorrow, and decades to come. Studies show that the loss of GPS service would average a $1 billion per-day impact on the nation.[3]

GPSIA recognizes and appreciates that radiofrequency spectrum is a scarce resource that the Commission must manage in the public interest. But simply analyzing data – however the data set is defined – is an ineffective way to measure spectrum usage and represents one of the limitations of the Commission's proposed techniques to understanding non-Federal spectrum usage. It is critical that the Commission consider the varying service, operational, and technical characteristics of how spectrum is used to obtain an accurate picture and develop appropriate policies.

Specifically, the Commission should recognize that there are differences between navigation systems like GPS and commercial communications systems that necessitate different spectrum evaluations. For example, devices that rely on GPS signals are receive-only and have technical characteristics and use cases that are different from communications-centric services,

[2] *See, e.g.*, RTI International, *Economic Benefits of the Global Positioning System (GPS)*, at ES-1 (June 2019) ("RTI Study"), https://www.rti.org/sites/default/files/gps_finalreport.pdf; Michael P. Gallaher, *Economic Benefits of the Global Positioning System (GPS), Presentation at the Positioning, Navigation and Timing Advisory Board Meeting* (Nov. 20, 2019), https://www.gps.gov/governance/advisory/meetings/2019-11/gallaher.pdf.

[3] *See* RTI Study at ES-4.

making evaluation of their use of spectrum using data alone difficult to achieve. Moreover, there are billions of devices that rely on GPS, creating a volume of GPS receivers that is impractical – if not impossible – to measure.

Any changes in spectrum policy that the Commission contemplates making based on its evaluation of spectrum usage must recognize that GPS devices are particularly affected by adjacent-band operations. Indeed, the Commission has historically maintained a "quiet neighborhood" around spectrum used by GPS devices, and the Commission should maintain that approach. The Commission must also ensure that any policies it adopts as a result of its spectrum usage assessment takes into consideration the large embedded user base of GPS devices, many of which cannot be changed without losing vital functionality.

Finally, the Commission should not adopt a receiver performance database in support of assessing spectrum use because of its administrative and financial infeasibility. The better approach to understanding GPS spectrum usage would be for the Commission, in addition to taking the factors above into consideration, to review previous Executive decisions and actions by the Department of Defense ("DOD") to fully understand the purpose and operation of GPS devices as well as their importance to national security.

II. THE COMMISSION SHOULD NOT ADOPT A ONE-SIZE-FITS-ALL APPROACH TO EVALUATING SPECTRUM USAGE

GPSIA wholeheartedly agrees with a key finding from the August 2014 Wireless Spectrum Research and Development ("WSRD") Senior Steering Group that "[t]here is not a one-size-fits-all approach to measuring spectrum usage."[4] The Commission should heed that

[4] *NOI* ¶ 22 (citing NITRD, *Understanding the Spectrum Environment: Data and Monitoring to Improve Spectrum Utilization* (Aug. 2014), https://perma.cc/EW5E-QYQ9 ("2014 NITRD Workshop Report")).

guidance, particularly with respect to GPS devices, which face unique challenges and require special considerations when it comes to determining their use of spectrum.

A. Challenges in Measuring Spectrum Usage Identified in 2014 WSRD Report are Further Entrenched in 2023

As an initial matter, the *NOI* asks respondents to identify data-related challenges – including data protection, privacy, and security – to evaluating spectrum usage.[5] The 2014 WSRD report noted that, "[r]ecognizing a fundamental tradeoff between spectrum efficiency and protection of privacy and security, challenges exist to ensure effectiveness of data while not revealing more than is necessary."[6] GPSIA agrees. Some companies allow users to "opt out" of sharing privacy related data and information, including GPS-driven location data, with third parties as a privacy protecting measure, limiting the ability to capture data regarding GPS-reliant devices. The uses of emerging but still brittle technologies such as artificial intelligence and machine learning to assess spectrum use can further exacerbate challenges created by privacy concerns. Worse, their use can erode public trust in the Commission if they inaccurately measure spectrum use due to the unpredictability of the technology, or expose information considered by the consumer to be private.[7] Accordingly, the Commission should recognize that any attempts to gather data about the use of spectrum by GPS device users may result in imprecise or incomplete information.

[5] *See id.* ¶¶ 28, 40.

[6] 2014 NITRD Workshop Report at 17.

[7] *See* Shannon Bond, *What Happens When Thousands of Hackers Try to Break AI Chatbots*, NPR (Aug. 15, 2023), https://www.npr.org/2023/08/15/1193773829/what-happens-when-thousands-of-hackers-try-to-break-ai-chatbots.

B. Measurement of Spectrum Use Must Acknowledge that Radionavigation Systems are Different than Radiocommunications Systems

In addition, in measuring and assessing metrics to determine spectrum usage, the Commission must appreciate the distinctions between navigation systems and communications systems. As navigation systems, GPS/GNSS operate fundamentally differently than radio communications systems, with inherently different technical and functional attributes. For instance, unlike communications systems, which operate above the noise floor, spread spectrum GPS signals are below the thermal noise floor when they are received. Moreover, while communications systems decode data bits, navigation systems measure the precise timing of bit transitions in order to derive precise timing and positioning information. These sub-nanosecond measurements of bit edges require wide receiver bandwidth, which also aids in effective multipath rejection. Most GNSS system receivers further rely on continuous tracking of the signal carrier of each satellite being tracked to attain maximum accuracy.[8] And all GNSS receivers track the pseudo random noise code ("PRN code") from selected satellites in view, which is accomplished in the code tracking loop, which synchronizes a locally generated replica PRN code with the PRN code broadcast from the satellite and allows the receiver to make a precise measurement of the starting edge of the first bit of the PRN code sequence as it repeats.

GPS/GNSS receiver manufacturers have invested significant resources in research, development, testing, and evaluation to create receivers that can detect extraordinarily "quiet" signals from the noise and continuously track the signals emitted by GPS satellites. But even minor increases in the noise floor can impede the ability of GNSS receivers to extract signals

[8] By continuously tracking the carrier and measuring its phase at the time of measurement (the "carrier phase"), relative motion with respect to the satellites can be ascertained at sub-centimeter levels. Lack of continuous carrier phase renders many high precision applications, such as surveying, precision agriculture, unmanned aircraft operations, and connected vehicle operations, unavailable.

from the noise, thereby degrading performance. Because many receivers are used in safety-of-life applications, the Commission must consider these fundamental differences in navigation and communications systems, as well as GPS use cases, in determining how to define, collect data about, and assess spectrum usage. These differences can impact the definition of "spectrum usage," the data that is collected to measure spectrum usage, the selection of instruments used to collect that data, the measurements themselves, and any resulting assessments.

If these differences are not taken into consideration, the Commission could develop an inaccurate picture of the spectrum needs of GPS users, which may result in regulatory action that impacts their use. Given the importance of GPS and GNSS to safety-of-life, the domestic and global economies, critical infrastructure sectors, and the daily activities of individuals worldwide, the Commission's efforts at spectrum management, including measurement and assessment of spectrum usage, must take these factors into account to ensure continued availability of signals that deliver critical information to services that rely on GPS. To do so would put into practice the Commission's recognition in the *NOI* "that there are special considerations with regard to public safety and critical infrastructure needs."[9]

C. Measurement of Spectrum Allocated to GPS Must be Tailored to the Unique Aspects of GPS

The Commission should further consider the sheer volume of GPS receivers in the marketplace as an important measure of spectrum usage. There can be little question that spectrum that supports GPS and GNSS devices is intensely employed. In fact, worldwide, GNSS manufacturers have produced more than six billion GPS/GNSS receivers, and there are

[9] *NOI* ¶ 18.

currently well over one billion receivers currently in use in the U.S. alone.[10] The spectrum allocated to GPS is used every day, at all times of the day, to support the myriad use cases that GPS receivers enable for consumers around the globe.

It is also important to note that spectrum usage differs for each GPS use case. Some GPS receivers are always "listening" for GPS signals so that they can turn the signal into information that is combined with other sensor data to provide greater value to the consumer. For example, systems that monitor and warn first responders and the public of earthquakes, where data from seismometers is combined with GPS locational data, must rely on the continuous reception of GPS signals to operate and provide life-saving information at unpredictable intervals in time. Others, such as GPS receivers embedded within emergency handsets, rely solely on GPS signals to deliver value and may be used intermittently, and at times seasonally, but are extremely important in time-sensitive, safety-of-life critical moments, as recognized by the *NOI*.[11]

To the extent possible, the Commission must take into consideration the myriad GPS devices available in the marketplace as well as the continuity of the GPS signal required for those devices to operate properly. Both are important indicators of GPS spectrum usage.

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[10] *See* European Union Agency for the Space Programme, *EUSPA, EO and GNSS Market Report*, at 20 (2022) ("EU Market Report"), https://www.euspa.europa.eu/sites/default/files/uploads/euspa_market_report_2022.pdf. A few years ago, the EU Market Report estimated that more than six billion GPS/GNSS receivers were in use worldwide. *See* J. David Grossman, *Freedom to Innovate Promotes GPS Resiliency*, GPS World (Aug. 1, 2019), https://www.gpsworld.com/freedom-to-innovate-promotes-gps-resiliency/. At that time, there were approximately one billion GPS devices in use in the U.S., most of them in the private sector. *See* Space-Based Positioning Navigation & Timing National Advisory Board, *National Space-Based Positioning, Navigation, and Timing Advisory Board, Twenty-Fourth Meeting*, at 14 (Nov. 2019), https://www.gps.gov/governance/advisory/meetings/2019-11/minutes.pdf.

[11] *See NOI* ¶ 18.

III. MISAPPLYING SPECTRUM USAGE DEFINITIONS, TOOLS, MEASUREMENTS, AND ASSESSMENT FRAMEWORKS MAY LEAD TO ERRONEOUS CONCLUSIONS

The *NOI* invites respondents to comment on "the appropriate size of the band segment for possible study."[12] Although the WSRD report concludes that "[t]he services and operations of systems within a specific band drive the data needs and it use" and "spectrum monitoring and information development need to be band specific,"[13] band-specific monitoring alone is not sufficient, particularly with respect to the bands in which GPS devices receive signals. Spectrum allocations within a band must also be measured differently, depending on its use. For instance, different types of systems are licensed to operate within the L band and adjacent spectrum in which GPS operates. All of these must be taken into consideration, whether for radionavigation services such as GPS, wireless communications, or other communications services. And any definitions, tools, measurements, and assessment frameworks of spectrum usage must be specifically tailored for GPS given their distinctive differences. Misapplying spectrum usage tools, and measurements designed for communications systems would result in incorrect assessments of GPS spectrum usage.

A. The Commission Must be Mindful of Adjacent Bands when Considering the Applicability of Significant Changes to Spectrum Policies After Considering Spectrum Usage

GPS/GNSS receivers have been optimized over the past 30 years and have been designed to block some signals outside their bands. But it is unrealistic to expect all receivers to block *all* signals. Size and cost constraints limit the abilities of receivers to implement any and all types of mitigation. And some improvements in receiver blocking come at the expense of receiver

[12] *Id.*

[13] 2014 NITRD Workshop Report at 5.

performance. Sensitive receivers that by design capture faint signals (like GPS devices) may experience a degradation in performance if they are forced to tolerate markedly stronger adjacent-channel signals, even if they are completely redesigned.

In an acknowledgement of this reality, the Commission has historically maintained an appropriately quiet spectrum neighborhood – populated by similar spectrum users – for technologies that by design rely on faint radio signals and sensitive equipment, such as GPS receivers. Maintaining this "quiet neighborhood" has not only been necessary to ensure the ability of GPS receivers to operate, but it also has created an efficient use of spectrum.

Consistent with this approach, the Commission should ensure that any evaluation of spectrum usage consider the fact that use of spectrum *adjacent* to GPS operations is – and should remain – limited to services that are compatible with GPS operations. To hold otherwise could result in policies that allow the proliferation of users with significantly different technical parameters in spectrum adjacent to GPS. For instance, if the Commission is erroneously led to believe that spectrum adjacent to GPS is "underutilized" simply because it was intentionally maintained to serve as a "quiet neighborhood," the Commission could conclude that adjacent-band spectrum can be licensed at greater power levels, degrading the ability of GPS receivers to provide important services. Given the many different examples of highly successful and near ubiquitous spectrum usage with very different technical characteristics, such as GPS, satellite radio, and low-power unlicensed applications, it would be inappropriate for the Commission to evaluate spectrum usage of a particular device or service without carefully considering all the spectrum, including adjacent-band, needs of that device or service.

B. The Commission Must Consider the Extent and Cost of Impacts to the Embedded User Base from New Services

It is particularly important that the Commission accurately capture the spectrum use and therefore needs of GPS receivers because, as the Commission recognizes, spectrum management initiatives, including attempts to optimize spectrum usage, may involve the modification or replacement of receivers affected by its decisions.[14] GPS receivers often have a very long useful life, and GPS-enabled equipment can be highly integrated, with the GPS devices being only one component of a system. There are also numerous industry segments that depend on the reliable reception of GPS and have already invested many billions of dollars in their systems to provide critical devices and services requiring high reliability and integrity, including those used in public safety, safety-of-life, food security/precision agriculture, and critical infrastructure environments. In many instances, it may be impossible, impractical, or cost prohibitive to retrofit hardware, which may need to be retired and replaced well before the end of the equipment's useful life to comply with ill-advised regulatory mandates. With six billion receivers in use today, the cost of replacing them based on ill-advised spectrum management directives, would exceed tens of billions of dollars.

It is therefore vital that any policies developed because of the Commission's evaluation of spectrum usage take these factors into consideration. Manufacturers, consumers, and users of GPS devices may suffer significant lost investments that cause economic and market harms if the Commission fails to accurately evaluate their spectrum needs and/or forces them to alter their devices or uses to comply with Commission policies based on an inaccurate evaluation. That

[14] *See Promoting Efficient Use of Spectrum through Improved Receiver Interference Immunity Performance*, Notice of Inquiry, 37 FCC Rcd 5337, ¶¶156-61 (2022).

outcome would be clearly contrary to the public interest and, in some instances, inconsistent with the spirit of the Commission's digital equity agenda.

IV. A RECEIVER PERFORMANCE DATABASE IS INAPPROPRIATE AND ADMINISTRATIVELY AND FINANCIALLY INFEASIBLE FOR DECOUPLED RECEIVERS

The *NOI* asks questions about the practicality and efficacy of Commission spectrum usage databases and other potential sources of data.[15] While the number of GPS/GNSS receivers manufactured and used by consumers globally could be considered one measure of spectrum usage, GPSIA agrees with other parties that commented in response to a previous inquiry by the Commission on whether it should establish a receiver database that the Commission should *not* proceed with that approach.[16] Such a database would be burdensome on licensees and present particularly difficult, if not insurmountable, challenges for decoupled receivers.

Although GPS satellites are subject to extensive federal regulation, GPS receivers are decoupled from Commission licensing requirements and any centralized data collection process or mechanism.[17] As such, there is no obvious way for the Commission to be able to collect detailed GPS receiver information that could populate a comprehensive database given the vast numbers of receivers manufactured and in use today. It would therefore likely be administratively and financially infeasible to create a central source or mechanism to capture relevant data on the billions of devices that are in the hands of businesses and consumers across the U.S. today. The data privacy, and security issues noted above would also be exacerbated, which should further discourage the use of spectrum usage databases.[18] Like other commenters,

[15] *See NOI* ¶¶ 25-33.

[16] *See, e.g.*, Comments of McKay Brothers, LLC, ET Docket No. 22-137, at 7-8 (filed June 27, 2022).

[17] *See* Comments of Garmin International, Inc., ET Docket No. 22-137, at 14 (filed June 27, 2022).

[18] *See* discussion *supra* Section II.A.

GPSIA agrees that the Commission should not pursue a receiver performance database. And if the Commission chooses to create such a database, it should not include decoupled receivers.

V. IT IS ESSENTIAL TO UNDERSTAND THE IMPORTANT NATIONAL GOALS ACHIEVED BY ESTABLISHING GLOBAL PUBLIC TRUST IN THE INTEGRITY OF GPS SIGNALS

Finally, the Commission should recognize that it has available a variety of tools – other than potentially incomplete, inaccurate, or misleading data metrics – to understand spectrum usage. For instance, understanding the history of systems, particularly the origins of public-private partnerships grounded in government operated systems such as GPS, can provide the Commission with important information about spectrum used by GPS. Two Presidential policy decisions have played important roles in determining how and for whom spectrum allocated to GPS should be used.

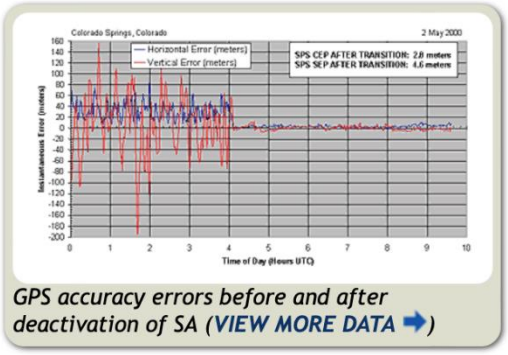
First, the GPS program design was approved and funded by the DOD in December 1973.[19] Although the DOD designed, developed, launched, and planned to integrate its capabilities into DOD operations, the system was also designed to support civil users. On September 16, 1983, President Reagan's administration announced that the United States would "make available to civilian aircraft the facilities of the Global Positioning System" and that "[t]his system will provide civilian airliners three-dimensional positional information."[20] This decision followed the tragic September 1 downing of Korean Air Lines Flight 007, which had inadvertently navigated into Soviet Union airspace. While President Reagan's initial goal was to make air travel safe for

[19] *See* Bradford Parkinson, *An Expurgated History of the GPS Revolution* (May 3, 2023), https://www.gps.gov/governance/advisory/meetings/2023-05/parkinson-2.pdf.

[20] Larry M. Speakes, Deputy Press Secretary, White House, Statement by Deputy Press Secretary Speakes on the Soviet Attack on a Korean Civilian Airliner, (Sept. 16, 1983), https://www.reaganlibrary.gov/archives/speech/statement-deputy-press-secretary-speakes-soviet-attack-korean-civilian-airliner-1.

the flying public, his policy decision also accelerated the development of a robust commercial GPS marketplace – one that is thriving today.

Second, after President Reagan's announcement, the DOD determined it was in the national security interest to intentionally degrade GPS civil signals, in what was called "Selective Availability."[21] And, in 2000, President Bill Clinton ended the use of Selective Availability, bringing an immediate improvement in the horizontal and vertical accuracies of GPS:[22]



GPS accuracy errors before and after deactivation of SA (VIEW MORE DATA)

This decision achieved another important national security goal: *establishing global public trust in the integrity of the GPS signal*. It also paved the way for numerous higher precision GPS-driven applications, such as precision agriculture, surveying, navigation, transportation, and many more.[23] Briefly examining these decisions will offer the Commission greater insight into the usage of spectrum by GPS as intended by our nation's leaders to achieve important national security and public safety goals that are still relevant today.

[21] *See Selective Availability*, GPS.GOV, https://www.gps.gov/systems/gps/modernization/sa/ (last visited Oct. 3, 2023).

[22] *See id*.

[23] *See* Secretary of Commerce, *Fact Sheet: Civilian Benefits of Discontinuing Selective Availability*, GPS.GOV (May 1, 2000), https://www.gps.gov/systems/gps/modernization/sa/benefits/.

VI. CONCLUSION

GPSIA appreciates that the Commission has a long history of successfully managing the spectrum environment by grouping similar services together. That approach has maximized spectrum efficiency and allowed GPS, in particular, to become a globally-leading and ubiquitously deployed technology that enjoys the world's trust in its signal integrity. Continued U.S. leadership depends on adherence to a regulatory and policymaking environment that acknowledges the importance of GPS-reliant services, and their present spectrum uses and needs.

Respectfully submitted,

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