Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington DC 20054

In the Matter of	)	
	)	
Promoting Efficient Use of Spectrum through Improved Receiver Interference Immunity Performance	)	ET Docket No. 22-137

COMMENTS OF THE GPS INNOVATION ALLIANCE

The GPS Innovation Alliance ("GPSIA") respectfully submits these comments in response to the Notice of Inquiry in the above-captioned proceeding.[1] GPSIA recognizes and appreciates that radiofrequency spectrum is a scarce resource that the Commission must manage in the public interest. The Commission should consider many factors when it engages in spectrum management and must not inadvertently jeopardize services like the U.S. Global Positioning System ("GPS"), the characteristics of which are different from communications-centric services that the Commission has historically regulated. These differences have an important impact on the issues being considered in the *NOI.*

I. INTRODUCTION

GPSIA was formed to protect, promote, and enhance the use of GPS and Global Navigation Satellite System ("GNSS") technologies. GPS receivers are used in myriad government, military, commercial, and civilian applications. GPSIA members and affiliates are drawn from a broad cross-section of the economy and represent a wide variety of fields and businesses that are reliant on GPS. GPSIA includes organizations in the manufacturing, aviation, agriculture, construction, transportation, first responders, surveying, mapping, and defense industries and organizations that represent consumers who depend on GPS for boating and other

[1] *See Promoting Efficient Use of Spectrum through Improved Receiver Immunity Performance*, ET Docket No. 22-137, Notice of Inquiry, (rel. Apr. 21, 2022) ("*NOI*").

outdoor activities, and in their automobiles, farm vehicles, smart phones, and tablets. GPS is a highly innovative, successful, and ubiquitous technology that has injected $1.4 trillion into the nation's economy[2] and is critical to the smart infrastructure, services, and applications of today, tomorrow, and decades to come.

II. THE COMMISSION SHOULD ACKNOWLEDGE THAT THE UNIQUE CHARACTERISTICS OF GPS MUST BE CONSDIRED IN SPECTRUM MANAGEMENT DECISIONS

A. Commission Policies Must Take into Consideration the Fundamental Distinctions in Different Services.

GPSIA appreciates the spectrum management efforts that have been undertaken across the Federal government that acknowledge that the continued growth of GPS-enabled technologies is dependent on rigorously developed technical rules, interference protections, and a predictable spectrum environment.[3] While ensuring that a broad range of spectrum-based services can be successfully deployed, the Commission's spectrum decision-making must also consider the policy and public interest considerations that are necessary to ensure the continued success of GPS and the functioning of GNSS receivers, including their protection, using internationally-accepted criteria.

As a navigation system, GNSS operates fundamentally differently than radio communications systems, with inherently different technical and functional attributes. In

[2] *See* 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, e.g.*, *Assessment of Compatibility Between Global Positioning System Receivers and Adjacent Band Base Station and User Equipment Transmitters*, Technical Memorandum, NTIA TM-20-536 (Dec. 2020), *attached to*, Letter from Kathy Smith, Chief Counsel, NTIA, to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 11-109, 12-340, *et al.* (filed Dec. 4, 2020).

contrast to communications services, the primary measurement in GNSS is the precise timing of bit transitions in the navigation signal. In turn, precise timing and positioning depends on sub-nanosecond measurement of bit edges and effective multipath rejection, which both require wide receiver bandwidth.

Further, although GPS signals and equipment have decades of optimization, unlike communications systems, which operate above the noise floor, spread spectrum GPS signals are below the thermal noise floor when they are received. For GPS and GNSS systems to meet the needs of existing and future users, it is essential that they be able to deliver a signal that is accurate, has integrity, and is available and continuous in nature. The accuracy,[4] integrity,[5] availability,[6] and continuity[7] requirements of space-based navigation systems, including those

[4] Accuracy is the difference between a GPS device's indicated position, velocity, and time ("PVT") and its actual PVT at any given moment. The accuracy requirements are highly use-case dependent, varying from tens of meters to less than a centimeter. In earthquake monitoring, for example, accuracy is extremely important both for measuring the imminence of quakes and for calculating post-quake displacement. Survey GNSS, precision agriculture, and intelligent transportation systems could not continue to function without accuracy. Yet, accuracy alone is insufficient for most GNSS applications; they also need integrity, availability, and continuity.

[5] Integrity is the ability of GNSS systems to provide timely warning to users of problems in the system or equipment and to shut itself down when it is unable to meet accuracy requirements. Safety-of-life aviation operations, such as precision approach and landing as well as Terrain Awareness Warning Systems, depend on integrity of the signal and system to avoid disasters and prevent loss of life. Without integrity, airport safety records would be worse and controlled flight into terrain accidents would rise. Like accuracy, integrity alone is insufficient to ensure functioning of GNSS.

[6] Availability describes how often a GNSS system is available for use when it satisfies accuracy and integrity requirements. A GNSS-based service that only provides PVT information with high integrity for short and unpredictable bursts is unsuitable for most applications. For example, even a momentary degradation of service during an aircraft precision approach or flight close to terrain may trigger a missed approach procedure requiring a pilot to climb to a safe altitude and then wait to be readmitted to the landing sequence. Simply put, all, if not most, ongoing uses require changes or suspension of operations if GNSS becomes momentarily unavailable. Data show that GPS, as it currently functions, meets service availability requirements nearly 100 percent of the time.

[7] Continuity evidences GPS's ability to provide the required level of service without unscheduled interruption. Momentary episodes of interference can significantly disrupt continuity for many use cases or applications. Providing high levels of continuity in the face of unpredictable and random interference is particularly difficult and may make potential applications of GNSS unviable. For example, the time between unscheduled interruptions must be long to ensure that standard surveying operations can be

that enable high-risk, high-consequence safety-of-life services, differ greatly from those of terrestrial high-power communications systems operating above the noise floor. Thus, even minor increases in the effective noise floor impede the ability of GNSS receivers to extract signals from the noise, thereby degrading performance.

The Commission must take into account these fundamental characteristics in regulating in a manner that may affect the interference environment. Increasing the noise floor decreases the availability of GPS services by impeding a receiver's ability to correlate and track the satellite signals. Although the brief loss of connectivity in a communications service may be inconsequential during a non-emergency situation, losing public safety, aviation, or other navigation services that rely on GNSS reception – even momentarily – could prove catastrophic. And the loss of GPS service would average a $1 billion per-day impact on the nation,[8] which in turn would impact nearly one billion GPS receivers in the U.S. alone.[9] 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 regulation must take these factors into account to ensure continued availability of services that rely on GPS.

conducted, driverless cars can navigate down the highway, and ambulances can reach unfamiliar destinations.

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

[9] As of 2019, there were approximately one billion GPS devices in use in the U.S., an amount that has certainly expanded in the succeeding three years, particularly in view of the EU Market Report's estimate of more than six billion GPS/GNSS receivers in use worldwide. *See* 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; J. David Grossman, *Freedom to Innovate Promotes GPS Resiliency*, GPS WORLD (Aug. 1, 2019), https://www.gpsworld.com/freedom-to-innovate-promotes-gps-resiliency/.

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

As the Commission recognizes, its spectrum management initiatives may involve the modification or replacement of receivers affected by its decisions.[10] 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. The numerous industry segments that depend on the reliable reception of GPS and the industry that supplies GPS-based technologies 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, 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. In these situations, manufacturers, consumers, and users may suffer significant lost investments that cause economic and market harms that would be clearly contrary to the public interest.

The Commission has long recognized the need to ensure regulatory certainty to spur investments in new and innovative technologies.[11] The Commission should be mindful that its regulatory actions determine whether there is sufficient certainty for manufacturers to engage in business planning, product development, and production without concern that their investments will be stranded. Without a sufficiently predictable spectrum environment and an understanding that the Commission will not routinely change its rules regarding the continued use of existing

[10] *See NOI* ¶¶ 156-61.

[11] *See, e.g.*, *Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Report and Order, 10 FCC Rcd 4695, ¶ 16 (1995) (acknowledging that "uncertainty about possible changes in our rules has deterred or prevented [entities] from committing greater capital or obtaining financing").

equipment, investments may be seriously jeopardized and incentives to invest in new technologies will be reduced. The Commission must therefore take care to provide certainty to ensure manufacturers are not dissuaded from investing and consumers are not left with equipment that may be rendered prematurely obsolete by fundamental changes in regulation.

While GPSIA members that manufacture GPS receivers follow responsible system design practices, it is well known that some mitigation techniques suit communications systems but may have deleterious effects on navigation systems. Manufacturers design and develop receivers that leverage their technical and business expertise. In turn, market-led forces determine the best performing products. Given the incredibly robust ecosystem of GPS-based technology that currently exists in the global marketplace, manufacturers and service providers are the best-positioned and most well-equipped to develop products and devices to operate successfully in the real-world spectrum environment.

III. THE COMMISSION MUST BE MINDFUL OF ADJACENT BANDS WHEN CONSIDERING THE APPLICABILITY OF SIGNIFICANT CHANGES TO SPECTRUM POLICIES

A one-size-fits-all mandate on receiver performance may degrade existing capabilities and performance and would stifle innovation. The Commission cannot assume that receivers redesigned to comply with Commission receiver mandates would be able to tolerate stronger signals in adjacent channels and permit a different class of adjacent channel use without any loss of performance or functionality. 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. In real-world environments, it is impractical to place highly sensitive receivers designed to capture faint signals from remote transmission facilities in spectrum immediately adjacent to spectrum used by high-power base stations. As such, the Commission should avoid placing services with significantly different technical parameters immediately adjacent to each other. 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 adopt a regulatory framework without carefully considering the applicability to and compatibility of incumbent spectrum uses.

At a time when markets are evolving at a faster pace than ever before, fundamental changes to the Commission's regulatory landscape must also be balanced against the cost of replacement, research and development expenditures, and decreased functionality of upgraded legacy devices. Excessive regulation, coupled with the potential need to undertake robust engineering and economic costs, could have the unintended consequence of decreasing the performance of new devices and services. Additionally, market-led forces determine the best performing products in highly mature markets and industries, obviating the need for additional standards for receivers or reception.

IV. CONCLUSION

The Commission has a long history of successfully managing the spectrum environment by grouping like services together, which in turn has maximized spectrum efficiency and allowed GPS, in particular, to become a world-leading and ubiquitously deployed technology. Continued American leadership necessarily depends on an adherence to a regulatory

environment that acknowledges the fundamental differences in spectrum-based services, avoids top-down mandates, and does not inadvertently stifle innovation.

Respectfully submitted,

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