Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Xona Space Systems, Inc.	)	
	)	File No. SAT-LOA-2023________
Application for Launch-and-Operational	)	
Authority for a Radionavigation-Satellite	)	
Service Constellation	)	

APPLICATION

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APPLICATION

Xona requests authorization to launch and operate the Xona System, a radionavigation-satellite service ("RNSS") constellation of 258 simultaneously operational non-geostationary orbit ("NGSO"), low-Earth orbit ("LEO") small satellites. The Xona System will provide enhancements to positioning, navigation, and timing ("PNT") for U.S. and international markets.[1] Consistent with Federal Communications Commission ("FCC") rules, Xona has submitted a Form 312, Schedule S, Technical Narrative, and related exhibits.[2]

Today, more than 6.5 billion devices rely on global navigation satellite systems ("GNSS"), specifically the U.S. Global Positioning System ("GPS"), for determining the accurate time and location required for their safe and continuous operation. The rise of modern technologies such as autonomy, drones, and Internet of Things ("IoT") is rapidly increasing this number, which is projected to surpass 10 billion active GNSS devices in coming years.[3] These devices form the

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[1] During the 15-year license term, replenishment satellites will prove necessary. Xona Space Systems, Inc. ("Xona") expects that approximately 60 satellites per year will launch to replace aging Xona System satellites approaching end of life given the expected satellite operational lifetime is 5 years.

[2] After completing Critical Design Review ("CDR"), Xona will provide a detailed orbital debris mitigation assessment report ("ODAR").

[3] *EUSPA EO and GNSS Market Report*, European Union Agency for the Space Programme (2022), https://bit.ly/3CuDqIo.

backbone of everything from modern transportation systems to mobile device functionality to critical infrastructure stability. Because GPS provides such tremendous benefit, its utility has led to growing dependency. Combined with a lack of alternatives, this increasing dependency poses a major risk to the U.S. economy and national security. Furthermore, modern technologies such as autonomous transportation and aerial mobility require accuracy and integrity levels beyond what current satellite navigation solutions can provide, and as a result, their proliferation is limited.

The Xona System will provide global RNSS to both commercial and government users. The service will enable rapid centimeter-level positioning through a secure transmission with unprecedented protection against service disruptions caused by radio frequency, cyber, physical, or other sources of harmful interference. The Xona System has been engineered specifically to provide these services while ensuring the Xona System does not act as a source of harmful interference to other in-band or adjacent band services. Xona has been actively coordinating with U.S. and foreign governments, as well as private industry, to ensure such protection.

I. INTRODUCTION

A. Xona Background

Xona is a private company incorporated in Delaware in 2019 and headquartered in Burlingame, California.[4] Xona's mission is to maximize the positive impact of modern technologies by providing the globally accessible and assured source of precise location and time needed for these modern technologies to operate safely at scale. To do so, Xona has combined the expertise of world-renowned Stanford University GPS Lab researchers with the invaluable experience of seasoned space industry professionals from the likes of SpaceX, Blue Origin, NASA,

[4] Xona is primarily a venture financed company. It has formed multiple industry partnerships to support the development of Xona's space, ground, and user segments.

and Lockheed Martin. This team partnered to develop the high-performance RNSS Xona System to provide the world's most accurate and resilient PNT services. It is maturing the commercial model for high-performance satellite navigation services well established by GNSS correction service providers that offer data for GNSS-based high-precision location today.

Since its founding, Xona has rapidly progressed toward realizing its company mission. In late 2021, Xona successfully field demonstrated its patented architecture at a U.S. government proving ground in California.[5] This technology is at the core of the Xona System and enables unprecedented levels of navigation performance from small, low-cost satellites.

Less than a year later, in May 2022, Xona became the first privately funded company to launch an RNSS mission.[6] In 2023, Xona announced several collaborations with leading industry partners to make the Xona service available in professional grade GNSS simulators. This arrangement ensures the GNSS community has access to the development and testing tools necessary to independently evaluate any potential interference concerns. These collaborations demonstrate Xona's commitment to protecting existing satellite navigation services through extensive internal interference analysis, testing, and coordination.

B. The Xona System

The Xona System will contain both space and ground components. It incorporates patented technology to combine precision position and timing references from multiple sources – including GPS L1, L2, and L5 and Galileo E1 and E5 signals; onboard sensors; Xona's space-to-ground and ground-to-space links; and Inmarsat's space-to-space links, if available – to precisely determine

[5] *See* Xona, Experimental Special Temporary Authority Grant, ELS File No. 1248-EX-ST-2021 (effective Aug. 19, 2021).

[6] *See* Jason Rainbow, *Xona to test GPS-alternative demo satellite with customer*, SpaceNews (June 7, 2022), https://bit.ly/44viihi.

the Xona satellites' orbital locations and enable them to transmit powerful and secure GPS-like ranging signals to end users.

The Xona System has been designed to achieve the following objectives:

- *Resilient Navigation and Timing.* Xona incorporates real-time signal integrity monitoring with an industry first full signal authentication available to civilian users. Xona's signal characteristics bring mitigation to sources of both malicious and unintentional interference. When combined with an ability to operate fully independently of current GNSS, these features provide protection against various service interruptions.
- *High Precision.* The system leverages Xona's patented architecture to transmit signals with centimeter-level precision, a more than tenfold improvement over current GNSS. Xona also carries state-of-the-art GNSS corrections and other data in the signal to enable users to rapidly achieve high accuracy while utilizing Xona as either a standalone system or as a complement to current GNSS.
- *Expansive Coverage.* With the initial phase of deployment (34 satellites), Xona can serve the contiguous United States (CONUS), parts of Canada, and broad regions of Europe. In the final deployment (258 satellites), the Xona System can provide full continuous coverage across the entire globe, including remote regions such as the poles.
- *Efficient User Integration.* The Xona System has been engineered in close collaboration with multiple industry leading companies that collectively produce more than a billion GNSS devices per year to ensure end users receive Xona service benefits with minimal downstream integration effort and without causing interference or disruption of existing services.

- *Cost Efficiency*. Xona is designing all Xona System components around reliability and cost-effectiveness to ensure the system can achieve the greatest possible impact. This consideration includes not only the design and deployment of the space and ground segments but also the cost of integration into user equipment and service subscription rates.

Core elements of the Xona System include a space and ground segment. Both are described in the subsequent sections and in more detail in the Schedule S and Technical Narrative.

1. Space Segment

The Xona constellation will ultimately include 258 satellites. All will utilize spectrum-efficient waveforms to broadcast RNSS on L-band and C-band frequencies that are allocated internationally for RNSS. The constellation is a tiered Walker Delta orbital configuration at 1080 km that will be deployed in phases (see Technical Narrative). The resulting coverage enables the Xona System to provide (1) GNSS enhancement services that increase accuracy and convergence time along with security and interference resistance; (2) an independent alternative to GNSS to derive precise time referenced to Coordinated Universal Time (or UTC) and location; and (3) GPS-level satellite visibility and geometry with full global coverage.

The Xona System qualifies as RNSS and space operation service ("SpaceOps"). RNSS is "[t]he determination of the position, velocity and/or other characteristics of an object, or the obtaining of information relating to these parameters, by means of the propagation properties of radio waves" for "the purpose of navigation, including obstruction warning."[7] The Xona System will deliver PNT to commercial and government users inside and outside the United States. SpaceOps is "the operation of spacecraft, in particular space tracking, space telemetry and space

[7] ITU RR No. 1.9; 1.10. *See generally* ITU RR No. 1.43.

telecommand."[8] The Xona System will precisely identify the locations of its satellites, monitor the satellites' health, and command satellite updates and safe space operations.

Below is a brief survey of the Xona System links. Table 1 captures the proposed frequency plan.

Table 1: Frequency Plan[9]

Band (MHz)	Link Direction	Link Type	Frequency Allocation Table Compliance
1164-1215[10]	space-to-Earth	service	yes (RNSS)
1525-1559	space-to-space (GEO-to-LEO)	TT&C[11] feeder	no (waiver requested in section IV)
1559-1610[12]	space-to-Earth	service	yes (RNSS)
1626.5-1660.5	space-to-space (LEO-to-GEO)	TT&C	no (waiver requested in section IV)
2025-2110	Earth-to-space	TT&C	yes (SpaceOps)[13]
2200-2290	space-to-Earth	TT&C (outside U.S. only)	yes (SpaceOps)
5000-5010	Earth-to-space	feeder	yes (RNSS)
5010-5030[14]	space-to-Earth	service	yes (RNSS)
8025-8400	space-to-Earth	TT&C	no (waiver requested in section IV)

[8] ITU RR No. 1.23.

[9] Xona will only passively monitor the readily accessible civilian GPS L1 (center frequency of 1575.42 MHz), L2 (center frequency of 1227.60 MHz), and L5 (center frequency of 1176.45 MHz) and Galileo E1 (center frequency of 1575.42 MHz) and E5 (center frequency of 1191.795 MHz) signals.

[10] The Xona System will operate in the 1180.51625-1200.51625 MHz band at the 1190.51625 MHz center frequency.

[11] TT&C is telemetry, tracking, and command.

[12] The Xona System will operate in the 1591.3225-1595.3225 MHz band at the 1593.3225 MHz center frequency.

[13] For the 2025-2110 MHz band, the international frequency allocation table includes a space operation service allocation, but the U.S. frequency allocation table does not. In case the Xona System uses U.S. TT&C earth stations, Xona seeks a waiver in section IV.

[14] The Xona System will operate in the 5011.3725-5029.3725 MHz band at the 5020.3725 MHz center frequency.

Service Links. All transmissions are from the satellites to user equipment (space-to-Earth). Both RNSS L-bands and C-band are allocated to RNSS on a co-primary basis in the international and U.S. federal and non-federal frequency allocation tables.[15] Xona has conducted extensive pre-coordination efforts with both federal and non-federal service operators in these bands and will continue such efforts, as well as international coordination efforts, to ensure the Xona System causes no harmful interference to existing GNSS or other services that share the RNSS bands or operate in adjacent bands. As the Technical Narrative shows, Xona's operations will not materially constrain operators from sharing the RNSS bands.

TT&C Links. The Xona System satellites will communicate with specific fixed locations. RNSS is different from communication systems by its nature because RNSS's relatively weaker signals are more susceptible to harmful interference and render TT&C in RNSS service bands impractical.

For commercial RNSS operators, little TT&C precedent exists outside current government operations, such as the U.S. GPS and European Galileo. For their TT&C links, the GPS[16] and Galileo[17] systems use S-band SpaceOps frequencies (2025-2110 MHz (Earth-to-space) and 2200-2290 MHz (space-to-Earth)). Xona requests authority for the same bands as well as the X-band Earth Exploration-Satellite Service ("EESS") frequencies (8025-8400 MHz (space-to-Earth)), on a non-conforming basis, given non-federal operators may not use the 2200-2290 MHz band inside the United States.

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[15] *See* 47 C.F.R. § 2.106.

[16] *Control Segment*, GPS.gov, https://bit.ly/3pCLYKH (last modified Aug. 9, 2021).

[17] *Galileo system*, European Space Agency, https://bit.ly/3pE9oiD (last visited Jun 25, 2023).

Feeder and Inter-Satellite Links. The Xona System will operate feeder links in the 5000-5010 MHz portion of the C-band. Such feeder links will take time to deploy because they are less of a commercial standard, and Xona will need a custom dedicated ground antenna network as well as custom radios. While C-band deployment is under development, the Xona System will utilize commercially available space-to-space links with authorized and coordinated Inmarsat geostationary orbit ("GSO") satellites. The Xona System will transmit in 1626.5-1660.0 MHz for TT&C downlink when out of range of ground stations and will receive in 1525.0-1559.0 MHz for both TT&C uplink as well as service data including GNSS corrections.

2. Ground Segment

Xona will handle operations from Xona's mission operations centers ("MOCs"), one of which will be in Burlingame, CA. The Xona ground component includes fixed Earth stations and receive-only fixed and mobile user equipment.

Fixed Earth Stations. Xona will leverage third-party providers for the fixed ground station network operations. Xona will also leverage third-party GNSS monitoring network providers to procure data from their Continuously Operating Reference Station networks. These third parties will secure all necessary Earth station authorizations before commencing operations.

Receive-only Fixed and Mobile Earth Stations. The Xona System ground segment also includes receive-only user equipment that will collect combinations of the Xona L-band and C-band RNSS transmissions. Given these Xona System user devices are receive-only and the device manufacturers design and construct the devices, Xona is not seeking authorization of any Xona System user equipment in this application.

II. PUBLIC INTEREST

Xona aims to deploy a commercial satellite-based PNT service to enhance resiliency, accuracy, and security of a technology (namely GPS) that has been the backbone of the U.S.

economy and national security for nearly 50 years. The Xona System combines the benefits of modern satellite and launch capabilities that continue to reduce cost with a cutting-edge patented LEO satellite navigation architecture to provide revolutionary PNT performance.

With the first satellite launched in February 1978 and full constellation completion in the mid-1990s, GPS unlocked a technology that has proliferated throughout the world. In turn, GPS has become the default source of location and time for everything from mobile phones to farming equipment and financial institutions. U.S. government-sponsored studies indicate that GPS has created over $1.4 trillion of economic benefit in the United States alone[18] and that any GPS outage would cost the United States $1 billion per day.[19] At the December 2021 PNT Advisory Board Meeting, the National Security Council Director for Resilience and Response called GPS "a single point of failure for critical infrastructure."[20] Threats to GPS disruption and demands for higher performance from modern applications are rising. Both are driving a critical and growing need for resilient and accurate GPS alternatives and augmentation.

The frequency of jamming incidents and GPS outages in recent years continues to increase. More than 50,000 disruptions were recorded in Europe alone between 2016-2018.[21] These disruptions can be caused by simple jammers or more sophisticated spoofers that can transmit counterfeit GPS signals, as civil GNSS signals largely lack encryption or authentication features and are not protected against these attacks. In 2019, researchers demonstrated this vulnerability in

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[18] Alan O'Connor et al., *Economic Benefits of the Global Positioning System (GPS)*, (2019), https://bit.ly/3KcTt27.

[19] Eric Berger, *Study finds that a GPS outage would cost $1 billion per day*, Ars Technica (2019), https://bit.ly/3NvGk6k.

[20] 25th Meeting December 9-10, GPS.gov (2021), https://bit.ly/3CqbPrW (last modified Apr. 27, 2022).

[21] Sarang Thombre et al., *GNSS Threat Monitoring and Reporting: Past, Present, and a Proposed Future*, 71 J. NAVIG. 513 (2018).

the automotive field by using a spoofing attack to create unsafe behavior in a consumer vehicle currently in production.[22]

GPS's increasing risks, threats, and vulnerabilities have long been recognized, and the U.S. government and industry have made several policies and recommendations to address these concerns. As early as December 2004, President George W. Bush issued National Security Presidential Directive 39, mandating the United States to develop, maintain, and modernize GPS, including providing a GPS backup capability in the event of GPS disruption.[23] In 2017,[24] and again in 2021,[25] the Alliance for Telecommunications Solutions urged Congress to establish one or more GPS alternatives. In 2020, President Donald Trump issued Executive Order 13905 to protect the national and economic security of the United States arising from disruptions to PNT services by "strengthening national resilience through responsible use of positioning, navigation, and timing services in critical infrastructure."[26] The 2021 National Defense Authorization Act specifically directs the Secretary of Defense to prioritize most critical mission elements and systems for combatant commands' operational plans and produce sufficient equipment "to generate resilient and survivable alternative positioning, navigation, and timing signals."[27] The Homeland Security

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[22] Roi Mit et al., *Analyzing Tesla's Level 2 Autonomous Driving System Under Different GNSS Spoofing Scenarios and Implementing Connected Services for Authentication and Reliability of GNSS Data*, ION GNSS+ 2020 621-46 (Sept. 2020), https://bit.ly/42G1jYn.

[23] The White House, *NSPD-39: U.S. Space-Based Position, Navigation, and Timing Policy*, (Dec. 15, 2004), https://bit.ly/3Jcizxp.

[24] Letter from Thomas Goode, ATIS General Counsel, to The Honorable Ed Markey et al., U.S. Senate (May 3, 2017), https://bit.ly/3JcBXdQ.

[25] Letter from Thomas Goode, ATIS General Counsel, to The Honorable Jack Reed et al., U.S. Senate (May 7, 2021), https://bit.ly/3CtjkOT.

[26] Executive Order on Strengthening National Resilience through Responsible Use of Positioning, Navigation, and Timing Services, The White House (Feb. 12, 2020), https://bit.ly/42zEJAp.

[27] National Defense Authorization Act for Fiscal Year 2022, Pub. L. No. 117-81, 135 Stat. 1541, https://bit.ly/3p0YD9N.

Infrastructure Protection Plan,[28] White House National Space Policy,[29] National Defense Authorization Act for Fiscal Year 2022,[30] Department of Transportation Complementary PNT and GPS Backup Technologies Demonstration Report,[31] and Cybersecurity and Infrastructure Security Agency Report on PNT Backup and Complementary Capabilities to GPS[32] all echo the urgent need for our nation to focus on GPS alternative technologies to mitigate risks to, strengthen the security of, and enhance the resilience of critical infrastructure and other major industries like agriculture and transportation.

Competition to deploy LEO-based GNSS alternatives and augmentation from other nations is mounting. Despite Xona launching the first ever commercially funded satellite navigation mission on May 25, 2022, Xona is still working through the regulatory framework to test its demonstration L-band satellite in the United States. Meanwhile, at least two Chinese competitors (Centispace and Geely) are already using RNSS L-band in China and are rapidly advancing their LEO PNT technologies.

The Xona System will serve the public interest by delivering an affordable high-performance GPS augmentation and alternative to the mass market that can be rapidly and easily

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[28] *Critical Infrastructure Security and Resilience*, Department of Homeland Security & National Coordination Office for Space-Based Positioning Navigation and Timing (Nov. 2014), https://bit.ly/43SHsGe.

[12] National Space Policy of the United States of America, The White House (Dec. 9, 2020), https://bit.ly/3JdXVgt.

[30] National Defense Authorization Act for Fiscal Year 2022, Pub. L. No. 117-81, 135 Stat. 1541, https://bit.ly/3p0YD9N.

[31] Andrew Hansen et al., *Complementary PNT and GPS Backup Technologies Demonstration Report Sections 1 through 10*, U.S. Department of Transportation Volpe Center (Jan. 2021), https://bit.ly/43SrSdC.

[32] Report on Positioning, Navigation, and Timing (PNT) Backup and Complementary Capabilities to the Global Positioning System (GPS), Department of Homeland Security (Apr. 8, 2020), https://bit.ly/3JcbY68.

integrated into current and future user equipment. Xona collaborated with multiple leading GNSS chipset and equipment manufacturers to specifically design the Xona System to provide the accuracy, security, and interference resistance necessary for safety critical operations of modern technologies while also minimizing the technical burden of integration into the billions of GPS devices produced every year. Xona has successfully demonstrated its RNSS service can be integrated on multiple existing commercial-off-the-shelf GNSS user equipment devices with as little as a software update. Through such partnerships, Xona is also ensuring rapid and easy integration of Xona services into future GNSS equipment. Xona System user equipment has a similar – if not identical – fit, form, and function as current GNSS user equipment. The user equipment does not require any transmissions to utilize the Xona System and can be integrated into numerous end-user applications, such as automobiles, cell phones, drones, time synchronization equipment, airplanes, and ships. Given the unique one-directional space-to-Earth broadcast nature of the Xona System, there is no limit to the number of devices that can receive service. By completion of the initial 34-satellite phase, Xona aims to have the Xona System capability integrated into over 100 million devices. And upon completion of the full-scale 258-satelite constellation, Xona System-enabled chipsets will be incorporated into the production of more than a billion new devices per year.

These same attributes also translate into many other valuable use cases that directly benefit the public interest, including:

- enhanced interference resistance for government users to enable operations in environments where GPS may be degraded or denied.
- protection against wide-area GPS interference for heavy transport sectors, such as maritime, rail, and aviation.

- continuous operation of critical national infrastructure, such as telecommunication networks, power grids, and financial institutions, in the event of a GPS disruption.
- improvements for safety of autonomous functionality where light detection and ranging or vision systems are degraded, such as dirty or dusty environments or inclement weather.
- enablement of mass mobile devices, such as cell phones, wearables, and IoT to achieve unprecedented precision on a global scale and to enhance current and new applications in geospatial intelligence, mapping, gaming, and productivity.
- reductions in global water, fuel, and fertilizer usage by unlocking high-efficiency precision farming in regions without highly developed local infrastructure.

III. ADDITIONAL LEGAL AND TECHNICAL INFORMATION

A. Legal

1. Coordination

Xona recognizes coordination is necessary in frequencies shared with federal systems as well as with existing and future non-federal systems (*e.g.*, Earth exploration-satellite, space research, aeronautical mobile satellite, or aeronautical radionavigation services). Xona remains committed to coordination and collaborative operations of its constellation and will optimize the efficient use of allocated spectrum to coexist with other space and terrestrial users without causing harmful interference. Xona will commence coordination immediately after submitting this Part 25 application and finalize coordination agreements before receiving FCC authorization. Given Xona has previously worked with Spaceflight to submit and secure approval for a Part 25 application for hosting an experimental Xona RNSS payload, Xona has experience identifying and coordinating with relevant parties.[33] Additionally, Xona will satisfy the international and U.S. frequency allocation tables and all corresponding footnote conditions except as noted in this application.

2. ITU Filing and Cost Recovery (47 C.F.R. § 25.111)

Xona is aware of its responsibility to pay any and all International Telecommunication Union ("ITU") fees and accepts responsibility to pay any ITU cost recovery fees associated with this application. Xona has separately submitted a formal ITU cost recovery letter and ITU filing, and invoices for related fees may be sent to the contact noted.

3. System Deployment Milestones (47 C.F.R. § 25.164)

Xona agrees to satisfy the NGSO deployment milestones.

4. Posting of Surety Bond (47 C.F.R. § 25.165)

Xona acknowledges that it may have to post a surety bond after this application's grant.

5. Reporting Requirements (47 C.F.R. §§ 25.171 *et. seq.*)

Xona will satisfy all FCC reporting requirements that already or may apply.

B. Technical

1. Orbital Debris Mitigation

Xona is committed to meeting all U.S. and international space safety requirements to ensure long-term debris mitigation and operational space safety. Xona is building its constellation to meet all space safety requirements and will incorporate best technologies and practices for safe space operations. See Technical Narrative for additional details.

2. Interference Showings

Xona is committed to implementing state-of-the-art technology that will enable coordination and prevent harmful interference. In the Technical Narrative, Xona has extensively

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[33] *See generally* Spaceflight, Stamp Grant, ICFS File No. SAT-LOA-20220111-00007 (granted in part May 10, 2022).

demonstrated that it will not cause harmful interference to other services. Xona will also satisfy the default service rules in 47 C.F.R. § 25.217.

IV. WAIVER REQUESTS

Xona respectfully requests certain FCC rule waivers. The Commission may waive any of its rules if there is "good cause" to do so.[34] Waiver is appropriate where "special circumstances warrant a deviation from the general rule[,]" and "such deviation will serve the public interest" better than strict adherence to the rule.[35] Generally, the Commission will grant a waiver of its rules if the relief requested would not undermine the policy objective of the rule in question and would otherwise serve the public interest.[36] The Commission may also consider potential hardship, equity, or policy implementation factors as part of its review.[37] Additionally, the Commission generally grants a waiver of the frequency allocation table "when there is little potential for interference into any service authorized . . . and when the non-conforming operator accepts any interference from authorized services."[38] Here, waiver grants will serve the public interest by

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[34] 47 C.F.R. § 1.3.

[35] *Northeast Cellular Telephone Co. v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990) (*Northeast Cellular*).

[36] *See WAIT Radio v. FCC*, 418 F.2d 1153, 1159 (D.C. Cir. 1969) (*WAIT Radio*); *Northeast Cellular*, 897 F.2d at 1166.

[37] *See WAIT Radio*, 418 F.2d at 1159.

[38] *The Boeing Company Application for Blanket Authority to Operate Up to Eight Hundred Technically Identical Transmit and Receive Mobile Earth Stations Aboard Aircraft in the 14.0- 14. GHz and 11.7-12.2 GHz Frequency Bands*, Order and Authorization, 16 FCC Rcd 22645 ¶ 12 (IB & OET 2001) (internal punctuation omitted). *See generally Application of FugroChance, Inc. for Blanket Authority to Construct and Operate a Private Network of Receive-Only Mobile Earth Stations, Order and Authorization*, 10 FCC Rcd 2860 (IB 1995); *Application of Motorola Satellite Communications, Inc. for Modification of License*, Order and Authorization, 11 FCC Rcd 13952 (IB 1996).

promoting the timely delivery of innovative PNT services without undermining the essential purpose of any of the identified FCC rules.

A. Processing Round (47 C.F.R. §§ 25.156, 25.157)

Xona requests waiver of the NGSO processing round framework and consideration of this application under the GSO first-come, first-served procedure.[39] Good cause exists for waiving a NGSO processing round.

FCC precedent supports such a decision. In 1999, Lockheed Martin proposed to use omni-directional L-band antennas onboard a GSO satellite for RNSS provision.[40] Such GSOs are typically considered NGSO-like satellites subject to the FCC processing round rules.[41] In this case, the FCC waived the processing round, however, for two reasons. *First*, "existing arrangements, including the ITU Resolution 609 and the presence of the U.S. GPS system in the band, constrain [the FCC's] ability to engage in band segmentation," which is necessary for NGSO processing rounds.[42] *Second*, RNSS licensees in the GPS L1 and L5 frequency bands must be compatible with the U.S. GPS system, and employing code-division multiple access signal structure and coordination permitted compatibility between Lockheed Martin and U.S. GPS systems.[43]

The same applies to the Xona System. Xona proposes to launch and operate a U.S.-flagged NGSO RNSS system that would serve critical public safety and national security purposes. As detailed further in the Technical Narrative, Xona will participate in the ITU Resolution 609

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[39] *See* 47 C.F.R. § 25.158.

[40] *See Lockheed Martin Corporation*, Order and Authorization, 20 FCC Rcd 11023 ¶ 2 (IB 2005) ("*Lockheed Order*").

[41] *See id.* ¶ 13.

[42] *Id.* ¶ 15.

[43] *See id.* ¶¶ 30-31.

consultative process to agree and equitably share aggregate equivalent power flux-density for planned and operational RNSS systems.[44]

The Xona System and existing and future co-frequency systems can coexist. Multiple RNSS interests, including the U.S. government, already enlist and share the RNSS bands.[45] Other NGSO RNSS interests, however, can use this spectrum inside the United States after Xona receives FCC approval outside a processing round. Xona has adopted a proprietary signal structure that promotes spectrum sharing where the Xona System signals occupy only a small spectrum segment between existing RNSS signals (see Technical Narrative) and agrees to coordinate with future entrants, as necessary. As shown in the Technical Narrative, Xona has completed analyses showing compatibility with Xona and existing RNSS and ARNS systems. In showing compatibility, existing resolutions and recommendations outlined by the ITU were employed and no modifications or updates to these methods are requested. As Xona has followed the methodology previously established of all global RNSS providers, future entrants into these frequency bands would also be able to follow these established criteria.

Opening a processing round would invite hardship for the Xona System. Few RNSS bands remain available, and the permissible global EPFD margin is filling quickly. For example, after an informal review of Xona's draft ITU filing earlier this year, the ITU staff asked Xona to modify its parameters, including power reductions, because of a new Chinese LEO RNSS system that is now operational. Further, FCC processing rounds take time to complete. Any delay is unacceptable for a new critical standalone PNT service, such as the Xona System. Any delay may also prompt

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[44] *See* Protection of aeronautical radionavigation service systems from the equivalent power flux-density produced by radionavigation-satellite service networks and systems in the 1 164-1 215 MHz frequency band, ITU-R Resolution 609 (WRC-07); *see also Lockheed Order* ¶ 28.

[45] *See GNSS Frequencies and Signals*, Hexagon, https://bit.ly/3Pd4a86 (last viewed June 14, 2023).

further modifications to Xona's ITU filing and FCC application because other administrations are already allowing others to operate while securing additional protections during international coordination meetings.

Administering first-come, first-served RNSS NGSO application processing advances and cements the U.S. and FCC policy to maintain space leadership and security. U.S. GPS and other RNSS systems already suffer from blocking, jamming, and service degradation. The Xona System will supplement and advance existing U.S. GPS to further enhance U.S. capabilities for next-generation PNT services. Expediting such U.S. offerings is necessary to compete with global actors, such as China, which has filed for and started coordinating NGSO RNSS systems based on already operational satellites.

B. Frequency Allocation Table (47 C.F.R. § 2.106)

TT&C cannot occur in RNSS-allocated bands at this time. RNSS is unlike traditional communication systems by its nature, and the relatively weaker signals are more susceptible to harmful interference. To overcome this shortcoming, Xona enlists non-RNSS bands, some of which the U.S. GPS and European Galileo operators have enlisted for TT&C. Not all may comply with the international or U.S. frequency allocation tables. The following sub-sections demonstrate how waiving the frequency allocation tables would not increase the interference potential into any authorized service. Further, as a non-conforming operator in these bands, Xona accepts any interference from authorized services.

1. 1525-1559 MHz

The proposed 1525-1559 MHz space-to-space usage is on a non-conforming, but non-interfering, basis. The band hosts a MSS space-to-Earth allocation.[46] The LEO-based Xona System

[46] *See* 47 C.F.R. § 2.106.

satellites would receive directly from GEO-based Inmarsat satellites in this band, however. Although the allocations in this frequency band do not include a directional indicator for space-to-space communications, the Xona System's reception of these frequencies will not in any way alter the interference environment, as the received signal will be indistinguishable in its technical characteristics from signals transmitted in the allocated space-to-Earth direction.

2. 1626.5-1660.5 MHz

The proposed 1626.5-1660.0 MHz space-to-space usage is on a non-conforming, but non-interfering, basis. The band hosts a MSS Earth-to-space allocation.[47] The LEO-based Xona satellites would transmit directly to GEO-based Inmarsat satellites in this band, however. The signals will occur on a limited basis for data requiring transmission prior to available downlink opportunities directly to earth stations. The signals will occur on frequencies that Inmarsat assigns to the spaceborne Inmarsat terminal onboard the Xona satellites. Inmarsat will assign channels to Xona consistent with its coordination agreements with other operators in the band to ensure that no other licensee will be transmitting at the same time and on the same frequency as Xona space-to-space transmissions and prevent harmful interference. The primary anticipated use is relay of GNSS correction and other service data with low latency to maximize effectiveness in achieving high precision orbit determination along with service data passthrough without the need to wait until the appropriate satellite is within view of a Xona Earth station. The communication protocol this link uses is designed to transmit the minimum amount of information necessary and only actively transmit when there is information to send. Xona, therefore, anticipates that any space-to-space transmissions from the Xona satellite will be extremely brief and infrequent and prevent any

[47] *See id*.

harmful interference to other operators even absent the time- and frequency-based coordination built into Inmarsat's channel-assignment process.

3. 2025-2110 MHz

The proposed 2025-2110 MHz Earth-to-space usage is on a non-conforming, but non-interfering, basis inside the United States. In this band, the international frequency allocation table hosts a SpaceOps Earth-to-space allocation, among others, while the U.S. frequency allocation table does not.[48] Xona will use the band for TT&C. Outside the United States, this use is consistent with the frequency allocation table. Inside the United States, this use is not consistent with the frequency allocation table. In case the Xona System uses U.S. earth stations, Xona seeks a waiver of the U.S. frequency allocation table.

Permitting the requested rule relief is justified. Numerous existing Earth exploration-satellite service and space research service operators enlist this band for TT&C subject to successfully coordinating the frequency usage.[49] Xona commits to similarly coordinate with co-frequency interests, including federal operators, to ensure no increase in potential interference. Further, a waiver is appropriate due to other RNSS systems, such as GPS and Galileo, use this band for TT&C and Xona's unique position as one of the first commercial RNSS providers.[50]

4. 8025-8400 MHz

The proposed 8025-8400 MHz space-to-Earth usage is on a non-conforming, but non-interfering, basis inside the United States. In this band, the international and U.S. frequency

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[48] *See id.*

[49] *See id.* § 2.106, n. US347.

[50] *Control Segment*, GPS.gov, https://bit.ly/3pCLYKH (last modified Aug. 9, 2021); *Galileo system*, European Space Agency, https://bit.ly/3pE9oiD (last visited Jun 25, 2023).

allocation tables host an Earth exploration-satellite service allocation, among others.[51] Xona will use the band for TT&C and, therefore, seeks waiver of the frequency allocation tables.

Rule relaxation is supported by at least six reasons. *First*, the Xona System will operate in a similar fashion to how these bands are used today although with comparatively less data downlinked. *Second*, contemporaneously filed technical analysis demonstrates co-existence is possible without harmful interference.[52] *Third*, non-EESS waivers have occurred subject to conditions on a case-by-case basis and on a non-harmful interference basis, which Xona intends to follow. *Fourth*, the Xona System supports other EESS systems by providing an advanced RNSS signal for use in radio occultation and reflectometry, for example, for expanded remote sensing capability. *Fifth*, the other available downlink (2200-2290 MHz) is unusable inside the United States given exclusive federal occupation. *Sixth*, a waiver is appropriate due to Xona's unique position as one of the first commercial RNSS providers with a lack of available spectrum practical for RNSS TT&C and data downlink.

C. Application Completeness (47 C.F.R. § 25.112(a)(1))

To the extent necessary, Xona requests waiver of the FCC rule stating that applications are "unacceptable for filing and will be returned to the applicant" if, among other potential defects, they lack "completeness of answers to questions [or] informational showing."[53] The FCC may accept and process a defective application, however, if an appropriate waiver request accompanies the application.[54] Xona will supply complete orbital debris compliance, as soon as it reaches CDR, and any supplemental information, as the Commission may request.

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[51] *See* 47 C.F.R. § 2.106.

[52] *See* Technical Narrative.

[53] 47 C.F.R. § 25.112(a)(1)

[54] *See id.* 25.112(b)(1).

V. CONCLUSION

As demonstrated in this application, the requested grant will serve the public interest. Xona, therefore, respectfully requests that the Commission authorize the launch and operation of the Xona System.

Respectfully submitted,

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