RESPONSE TO REQUEST FOR COMMENTS ON DEVELOPMENT OF A NATIONAL SPECTRUM STRATEGY

NTIA 2023-0003

DOCKET NO. 230308–0068

APRIL 17, 2023

Submitted by **Blue Origin**
Annie Chen, Senior Legal Counsel, Regulatory Affairs & Compliance
achen3@blueorigin.com
21601 76th Ave S, Kent, WA 98032
253-437-9300 x 19768

Blue Origin submits these comments in response to the Request for Comments ("RFC") of the National Telecommunications and Information Administration ("NTIA") seeking information for the development and implementation of a National Spectrum Strategy.[1] Blue Origin commends the NTIA for its initiative and its recognition of the importance of making available sufficient spectrum for next-generation space services, which include in-space servicing, assembly, and manufacturing ("ISAM") and launch activities. Creating clear processes for shared use and/or identifying spectrum for commercial use would create stability in mission planning, which is vital for an industry in which development and construction can be costly and time consuming. Further, providing the tools for U.S. companies to develop such capabilities will ensure that the United States remains a leader in the space industry, as well as advance the economic, scientific, technological and security interests of this nation, all of which serve vital government objectives.

Blue Origin designs and develops space launch vehicles with the primary focus of lowering the cost of spaceflight and promoting an enduring human presence in space. The company has successfully completed 22 missions to space, including six crewed New Shepard missions.[2] In 2021, Blue Origin and its partners[3] were selected by the National Aeronautics and Space Administration ("NASA") to design a commercially owned and operated space station, Orbital Reef. Blue Origin has also announced plans to deploy a lunar lander capable of delivering a wide variety of small, medium, and large payloads to the lunar surface.[4] Based on the company's experience with spectrum coordination with federal spectrum managers and satellite licensing regulatory processes, Blue Origin provides the following suggestions to help the NTIA manage the nation's spectrum resources and usher in the next generation of the U.S. space industry.

1 THE NTIA SHOULD SUPPORT COMMERCIAL SPACE AND LAUNCH SERVICES AND ALLOW NON-FEDERAL USE OF CERTAIN S-BAND FREQUENCIES FOR COMMERCIAL SPACECRAFT ENGAGED IN RENDEZVOUS AND PROXIMITY OPERATIONS ("RPO") AND LAUNCH ACTIVITIES.

Commercial vehicles visiting the International Space Station ("ISS") use the Common Communications for Visiting Vehicles ("C2V2") S-band radio specifications established by

[1] *See* Development of a National Spectrum Strategy, Request for Comments, Docket No. 230308-0068, NTIA ("RFC"); 88 Fed. Reg. 16244 (Mar. 16, 2023).
[2] *See Blue Origin Successfully Completes 22nd Mission to Space*, Blue Origin (Aug. 4, 2022), https://www.blueorigin.com/news/ns-22-mission-updates.
[3] *See NASA Selects Orbital Reef to Develop Space Station Replacement*, Blue Origin (Dec. 2, 2021), https://www.blueorigin.com/news/nasa-selects-orbital-reef-for-space-station-replacement/. The Orbital Reef team includes Boeing, Redwire Space, Genesis Engineering Solutions, and Arizona State University.
[4] *See Blue Moon*, Blue Origin, https://www.blueorigin.com/blue-moon/ (last visited Oct. 9, 2022).

NASA for proximity operations.[5] Similarly, NASA's Lunar Gateway is expected to operate using the same frequencies. To ensure that non-federal visiting spacecraft are compatible with existing and planned space stations and that future non-federal space stations, such as Orbital Reef, are compatible with all visiting spacecraft, the NTIA should support commercial space services and work with the Federal Communications Commission ("FCC") to allow non-federal use of the C2V2 S-band frequencies for RPO.[6] As the number of visiting vehicles to existing and planned space stations increases, space stations may use Code-Division Multiple Access ("CDMA") technology for communicating with multiple vehicles simultaneously to avoid harmful interference.[7]

With respect to launch services, the NTIA should work with the FCC to expeditiously conclude the FCC's pending rulemaking proceeding establishing a licensing framework and non-federal use of the S-band frequencies for launch activities, including checkout between launches, and on launch days from pre-liftoff through post-landing.[8] Prompt action would facilitate the growth of the commercial launch industry and would be consistent with H.R. 682 - Launch Communications Act, a bill now before the House Energy and Commerce Committee.[9]

Specifically, the NTIA should support the FCC's proposal to add a co-primary, non-Federal space operations (Earth-to-space) allocation in the 2025-2110 MHz band.[10] Additionally, the NTIA should encourage the FCC to remove the channel restrictions on non-Federal use of the 2200-2290 MHz band (space-to-Earth), allowing commercial operators to operate throughout the band.[11] Removing the current restriction would provide commercial operators greater spectrum flexibility. Because all frequency use would still be subject to a coordination process, Federal operators would be adequately protected from potential harmful interference. Additionally, Blue Origin urges the NTIA to support a change in the status of the non-Federal, space operations allocation in the 2200-2290 MHz band from secondary to primary.[12] A primary allocation would better support development of the

---

[5] *See, e.g., NASA Networks Empower Commercial Crew: Supporting 1st Commercial Launch of NASA Astronauts From U.S.*, National Aeronautics and Space Administration (May 31, 2020), https://www.nasa.gov/feature/goddard/2020/nasa-networks-empower-commercial-crew-supporting-1st-commercial-launch-of-nasa-astronauts-from-us; CADre Presentation, National Aeronautics and Space Administration, at 15-18 (Aug. 15, 2018), https://www.nasa.gov/sites/default/files/atoms/files/10_2018_cost_and_schedule_symposium-cadre_final.pdf (providing an overview of the C2V2 standard).

[6] *See RFC* Pillar #1 at ¶ 1.

[7] *Id.* at ¶¶ 1-2, 6; *see* Pillar #3 at ¶ 2.

[8] *See* Allocation of Spectrum for Non-Federal Space Launch Operations, Amendment of Part 2 of the Commission's Rules for Federal Earth Stations Communicating with Non-Federal Fixed Satellite Service Space Stations; and Federal Space Station Use of the 399.9-400.05 MHz Band, Report and Order and Further Notice of Proposed Rulemaking, ET Docket No. 13-115; RM-11341, FCC 21-44 (Apr. 22, 2021)("Commercial Space Launch Proceeding").

[9] *See* Launch Communications Act of 2023, H.R. 682, 118th Cong. § 1 (2023).

[10] *See Commercial Space Launch* Proceeding at ¶ 47.

[11] *Id.* at ¶¶ 52-54.

[12] *Id.*

commercial space launch industry by placing launch operators on an equal footing with other primary users, providing greater regulatory certainty, and incentivizing investment in launch technology, facilities, and space flight generally.

Blue Origin understands that authorized S-band use is essentially limited to 5 MHz channels, which greatly restricts data rates. In the short term (i.e., 1-3 years), Blue Origin recognizes that the limit may be difficult to change. Moving forward, however, launch vehicles should be able to operate on wider bandwidths and data rates of up to 10 Mbps to allow for additional capabilities.

Consistent with the shared use of the band, all non-federal use would be coordinated with federal operators. The relevant S-band frequencies are allocated for space and launch operations, and RPO and launch activities are consistent with telemetry, tracking, and command use of the frequencies. Accordingly, the proposed use is consistent with the domestic and international table of frequency allocations.

2 THE NTIA SHOULD NOT CONSIDER A DYNAMIC SHARING PROCESS FOR LAUNCH SERVICES.

Blue Origin does not support a dynamic sharing process for launch services.[13] A dynamic (i.e., real time) sharing process would require complex frequency agile systems.[14] Such systems would be prohibitively expensive to design and potentially very difficult to implement.[15] Further, command and control telemetry streams are required for public safety. A fixed allocation of spectrum for the duration of an operation ensures that those links are always active, and switching frequencies during an operation would break that link for a short period of time.

3 THE NTIA SHOULD SUPPORT NEW ALLOCATIONS FOR COMMERCIAL SPACE SERVICES, INCLUDING ISAM AND LAUNCH ACTIVITIES.

While allowing non-federal use of the C2V2 frequencies will support the development of RPO activities for spacecraft visiting the ISS and other space stations, the C2V2 frequencies are unlikely to be sufficient to support the expected growth of the space industry as a whole.[16] Additionally, commercial operators, including Blue Origin, have expressed interest in conducting lunar missions, which may require refueling operations. Such activities, as well as other operations requiring RPO, are likely to strain further the use of the C2V2 and Lunar

[13] *See RFC* Pillar #1 at ¶¶ 3, 6-7; Pillar #3 at ¶ 5.
[14] *See RFC* Pillar #1 at ¶ 7.
[15] *Id.*
[16] *See RFC* Pillar #1 at ¶ 2; Pillar #2 at ¶ 5.

Gateway S-band frequencies. Launch vehicles are also currently permitted to operate in the S-band frequencies subject to coordination. As the commercial space and launch sectors grows, congestion and conflicts will increase. Accordingly, adoption of new spectrum allocations for commercial space and launch services is necessary for the growth of the commercial space and launch industries,[17] and the NTIA should work with the FCC to identify additional spectrum bands for such services.[18]

3.1 ISAM Activities

Blue Origin recommends targeting frequency bands that would provide at least 100 MHz of bandwidth via multiple 10 MHz channels to facilitate sharing, and transitioning existing protocols to further commercial space services.[19] Sharing opportunities could also be expanded by implementing a spreading sequence with individual assignments restricted to a limited period of time based on the operator's specific use case.[20]

In selecting potential spectrum bands, Blue Origin recommends that the NTIA consider bands that would permit omni-directional use with power levels sufficient to establish initial connections at approximately 30 km distance and that could be cost-effectively developed.[21] These requirements would exclude bands higher than the Ka-Band or V-Band frequencies.

Additionally, the NTIA should support the allocation of frequencies for ISAM use across all orbits, allowing services to be provided from low-Earth orbit ("LEO") to lunar orbital regions (*i.e.*, LEO, medium-Earth orbit, geostationary transfer orbit, geostationary orbit ("GEO"), cis-lunar, lunar).[22] Such flexible allocations would allow operators to standardize equipment across different mission types, reducing operational and development costs and allowing operators to engage in more versatile missions operating across all orbital domains.

The NTIA should also support the use of intersatellite links in the Ka-band Fixed Satellite Service ("FSS") as another method for alleviating spectrum congestion for new space activities.[23] Such use is consistent with NTIA's proposal for WRC-23 Agenda Item 1.17 and the extensive studies performed in the International Telecommunication Union Radiocommunication sector, demonstrating that appropriately conditioned satellite-to-

[17] *See RFC* Pillar #1 at ¶¶ 1-4.
[18] *Id.* ISAM operations can be simplified if the relevant spacecraft can communicate directly. Such inter-satellite links can be used as radio beacons to perform ranging and to exchange state vectors and equipment status.
[19] *Id. at* ¶¶ 3-5.
[20] *Id. at* ¶¶ 4, 6; *see* Pillar #2 at ¶ 3.
[21] *See RFC* Pillar #1 *at* ¶ 4.
[22] *Id.* at ¶¶ 1, 3-4.
[23] *Id.* at ¶¶ 1-4.

satellite links in the Ka-band frequencies would not raise interference issues to other incumbent services.[24]

3.2 Launch Activities

The NTIA should support the use of the non-federal 400.15-401 MHz (space-to-Earth), 401-402 MHz (space-to-Earth), 450-455 MHz (Earth-to-space), and 455-456 MHz (Earth-to-space) bands for launch services.[25] The 400.15-401 MHz band is allocated for space operations on a secondary basis, among other uses, and the 401-402 MHz band is allocated for space operations on a primary basis, among other uses, under both the domestic and international table of frequency allocations.[26] Both the 450-455 MHz and 455-456 MHz bands are allocated for fixed and/or mobile services on a primary basis under the international table of frequency allocations.[27] In the domestic table of frequency allocations, the 450-455 MHz band is allocated for mobile, fixed, and/or land mobile services. Similarly, the 455-456 MHz band is allocated for land mobile services on a primary basis.[28] Given the limited duration of launches, Blue Origin believes use of these bands for launch services would not cause harmful interference to other authorized services. These frequencies provide reliable, low data rate (20 Kbps) that serve as a critical secondary communications system.

To the extent the NTIA supports the adoption of other frequency allocations that are not currently being used for launch services, such as the 5650-5925 MHz band, the NTIA should consider the transition time and costs for commercial operators to shift to new frequencies and allow a grace period for launch providers to gradually conform to new allocations.[29] New frequency allocations require updates to the communication systems on launch vehicles, as well as new ground stations or upgrades to existing ground stations. Additionally, a number of factors contribute to the complexity in changing equipment, including the dynamic movement and distances for launch vehicles, causing unpredictable received signal levels; the signal levels at various angles for different frequency bands; and the propagation losses for radio signals at higher frequencies, potentially requiring higher power transmissions. A transition period would ease these technical challenges that come from adoption of new spectrum allocations.

---

[24] *See* Letter from Steve Molina, NTIA, to Tom Sullivan, FCC (Jan. 9, 2023), *available at* https://www.fcc.gov/ecfs/document/104062381209830/40; *Conference Preparatory Meeting for WRC-23*, Plenary Meeting, Working Group 4: Chapter 4, Agenda Item 1.17, CPM23-2/271-E, ITU (Apr. 5, 2023), *available at* https://www.itu.int/md/R19-CPM23.2-C-0271/en.

[25] *See FCC Online Table of Frequency Allocations*, FCC, at p. 27 (July 1, 2022), *available at* https://transition.fcc.gov/oet/spectrum/table/fcctable.pdf.

[26] *Id.* at p. 27.

[27] *Id.* at p. 28.

[28] *Id.*

[29] *See RFC* Pillar #1 *at* ¶¶ 2 -4.

4 THE NTIA SHOULD SUPPORT THE USE OF ULTRA-WIDEBAND ("UWB") TRANSCEIVERS FOR SPACE-TO-SPACE TRANSMISSIONS ASSOCIATED WITH RPO ACTIVITIES.

UWB technology would be a critical enabling technology for RPO activities. By deploying essentially commercial off-the-shelf UWB transceivers on spacecraft, operators would be able to cost-effectively use small, light-weight, and low-power equipment for close-range RPO activities. In contrast, state-of-the art LiDAR equipment used for the same positioning and attitude sensing capabilities would cost two orders of magnitude more and also require greater operational power.

Importantly, use of UWB transceivers for RPO activities would not create risk of interference to other authorized spectrum users. UWB transmissions would be brief and low power and have a limited range. Additionally, because RPO activities would not normally occur when other spacecraft are nearby, there would be little to no risk of potential harmful interference to other authorized spectrum users.

Blue Origin is aware that current rules prohibit use of UWB devices on aircraft, ships, and satellites, a restriction that would apply to RPO activities for spacecraft engaging in ISAM.[30] This prohibition was intended to protect services that rely on high-gain receive antennas, such as satellites and aeronautical services, from the potential cumulative effects of widespread use of UWB devices.[31] Allowing UWB devices to be utilized for the limited use of RPO missions would not raise the concerns addressed by the prohibition. As noted above, the use of UWB devices for precision navigation purposes during RPO activities would be brief and performed in areas where no other spacecraft are nearby. In addition, while spacecraft operations are growing, the number of missions would remain relatively low and dispersed, allaying any concerns about the cumulative impact on victim receivers from widespread use of UWB devices.[32]

The original technical approach for UWB transmission systems in 2002 was based on a very conservative NTIA assessment in light of the nascency of the technology. The NTIA should reassess its 20-year conclusions about use of UWB devices on spacecraft and allow such use for RPO activities.

---

[30] *See In the Matter of Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, First Report and Order, ET Docket No. 98-153, FCC 02-48, at ¶¶ 233-34 (Apr. 22, 2002); 47 C.F.R. § 15.521.

[31] *Id.* at ¶ 233.

[32] *See, e.g., NTIA Special Publication 01-43, Assessment of Compatibility between Ultrawideband Devices and Selected Federal Systems*, U.S. Dep't of Commerce (Jan. 2001); *NTIA Report 01-383, The Temporal and Spectral Characteristics of Ultrawideband Signals*, U.S. Dep't of Commerce (Jan. 2001).

Additionally, the NTIA should support UWB transceivers to be used as sensors for facilitating launch activities. UWB transmissions in these cases would be limited, brief in duration, and low power, ensuring that there would be little to no impact on other authorized services.

5 THE NTIA SHOULD INCREASE TRANSPARENCY IN FEDERAL COORDINATION EFFORTS INVOLVING SHARED FREQUENCY BANDS.

The use of the S-band frequencies by federal agencies is extensive. Commercial operators using these shared bands generally must pre-coordinate with federal spectrum managers – a process which is time-consuming and burdensome for all parties. Additionally, for commercial operators, the process lacks transparency and certainty, which is important for mission planning and the development of reliable commercial services.

While federal spectrum managers have welcomed pre-coordination discussions and generally worked cooperatively with commercial space operators and associations, such as the Commercial Smallsat Spectrum Management Association, the process is generally one-sided, with commercial operators simply limiting proposed mission activities to address unknown or unstated federal concerns or issues. For example, coordination of C2V2 S-band frequencies for missions to the ISS may result in multiple standdown times and locations and other operating restrictions.[33] Such restrictions are both frustrating and potentially harmful to established mission plans.

Blue Origin encourages the NTIA to explore methods to improve transparency in these coordination processes, which would allow commercial operators to better address spectrum concerns of federal spectrum managers and improve mutual use of shared frequency bands.[34] The NTIA should also establish procedures in the event parties to coordination efforts are unable to agree. For the same reasons, Blue Origin supports the NTIA proposal to create additional working committees to help address frequency sharing matters, including the establishment of reasonable analysis-based interference standards.[35]

[33] *See, e.g.*, *Experimental Grant*, Space Exploration Technologies Corp., ELS File No. 0023-EX-ST-2022, at Condition 19 (granted Feb. 17, 2022) (imposing six S-band blackout zones on grant of STA for communication between Dragon capsule and SpaceX Crew vehicle mission to the ISS).
[34] *See RFC* Pillar #2 at ¶¶ 1, 3, 5, 7.
[35] *See RFC* Pillar #2 at ¶ 5.

6 THE NTIA SHOULD HELP DRIVE INTERNATIONAL EFFORTS TO CREATE NEW ALLOCATIONS FOR NEXT-GENERATION SPACE CAPABILITIES, INCLUDING ISAM OPERATIONS.

Allocation of sufficient spectrum for space services, including ISAM activities, is critical to the development of the space industry.[36] Accordingly, the NTIA should participate in international efforts to create such allocations. Blue Origin is aware that there are currently efforts to identify frequency bands for on-orbit services internationally and urges the NTIA to drive international efforts.[37] For example, as discussed above, the NTIA should support the use of intersatellite links in the Ka-band FSS as a method for alleviating spectrum congestion for new space activities.[38]

[36] *See RFC* Pillar #3 at ¶¶ 1-3.
[37] *See Proposal for WRC-23 consideration - Agenda item 7 new Topic - Regulatory provisions for TT&C frequencies for non-GSO In orbit servicing (IOS) satellite systems*, Astroscale Ltd. (May 4, 2022), https://www.itu.int/md/R19-WP4A-C-0663/en. The "study of spectrum for space operations", including the discussion on spectrum needs for on-orbit servicing, was listed as a potential topic under Agenda item 7 by Working Party 4A ("WP4A") at its May 2022 meeting. WP4A ultimately removed the topic from the Agenda item 7 list of issues at its September 2022 meeting.
[38] *See supra* note 24 and accompanying text.