Comments of Garmin International

Responding to the National Telecommunications and Information Administration Inquiry Regarding the Development of a National Spectrum Strategy

Docket No. NTIA–2023–0003

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EXECUTIVE SUMMARY

Garmin has a long history of cooperation and collaboration with the NTIA on a variety of spectrum and regulatory matters and appreciates the opportunity to provide comments on the development of a National Spectrum Strategy ("NSS"). In addition to seeking to make additional spectrum available, the NSS must evaluate key factors such as safety-of-life, technical compatibility, and the installed base of fielded user equipment.

Spectrum utilized for safety-of-life services must be valued for more than the data throughput it provides. Any consideration of bands for the spectrum pipeline must take into account the need to protect and preserve safety-of-life services – both in the band(s) under consideration as well as spectrally proximate bands. Additionally, the life cycle of the installed base of fielded equipment in the band under consideration, as well as adjacent bands, must be understood and its transmitter and receiver performance characteristics quantified in order to allow the assessment of technical compatibility between new entrants and incumbent services.

The identification and preservation of "spectrum neighborhoods" fosters innovation and creates opportunities to rapidly deploy new services. It also recognizes critical differences between communication and navigation technologies and provides spectral space for each to function without interference as defined by appropriate, service-specific interference protection criteria.

The NSS should guarantee that all stakeholders have an opportunity to participate in the long-term spectrum planning process in order to promote transparency to the greatest extent possible and ensure efficient and effective use of the nation's spectrum resources.

COMMENTS OF GARMIN INTERNATIONAL, INC.

Responding to the National Telecommunications and Information Administration Inquiry Regarding the Development of a National Spectrum Strategy

Docket No. NTIA–2023–0003

Garmin International, Inc. ("Garmin") hereby offers these comments in response to the National Telecommunications and Information Administration's ("NTIA's") *Request for Comments* in the above-captioned docket.[1] This docket "seeks broad input from interested stakeholders, … on three proposed pillars of the National Spectrum Strategy."[2] Garmin submits these comments to ensure that the NTIA's National Spectrum Strategy ("NSS") takes into account the vital role, from both an economic and safety-of-life perspective, that Federal spectrum allocations for navigation, communication, and air traffic surveillance services such as Global Navigation Satellite Systems ("GNSS"),[3] weather radars, voice and digital communication links, and air traffic control surveillance plays in benefiting non-federal users in our nation and the importance of ensuring that their transmitters and receivers continue to function efficiently and effectively.

Garmin, together with its worldwide affiliates, is a leading, worldwide provider of navigation, communication, and surveillance equipment, committed to making superior products for automotive, aviation, marine, outdoor, fitness, and sports uses that are an essential part of its customers' lives. Since its founding in 1989, Garmin has evolved as a global leader in the markets it serves, many of which are enabled by GNSS technology. Garmin's broad, overall product portfolio serves a wide variety of customers.

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[1] 88 FR 16244, Development of a National Spectrum Strategy, *Request for Comments*, NTIA, Docket No. 230308–0068 (rel. Mar. 16, 2023) ("*RFC*").

[2] 88 FR 16245.

[3] In these comments, GNSS is a general term describing any satellite constellation that provides positioning, navigation, and timing ("PNT") services on a global or regional basis such as the U.S. Global Positioning System ("GPS"). In these comments, GNSS also encompasses Satellite Based Augmentation Systems ("SBAS") such as the Federal Aviation Administration's ("FAA's") Wide Area Augmentation System ("WAAS").

I. PILLAR #1—A SPECTRUM PIPELINE TO ENSURE U.S. LEADERSHIP IN SPECTRUM-BASED TECHNOLOGIES

Garmin commends NTIA for a forward-thinking approach that seeks to maintain U.S. technological leadership. Spectrum is indeed a scarce resource, and efforts to use it safely and efficiently are needed. The *RFC* defines "spectrum pipeline" as "a process for identifying spectrum bands, regardless of allocation (*i.e.*, both federal and non-federal) that should be studied for repurposing (*i.e.*, allowing new or additional uses) to meet future requirements for non-federal and federal use alike."[4] Rather than lobby for particular bands, technologies, or services to be considered for repurposing, Garmin wishes to respond more broadly to questions 4 and 5 posed in Pillar #1.

A. Question 4: What factors should be considered in identifying spectrum for the pipeline?

More important than particular bands interested parties may wish to pursue for spectrum repurposing are the universal factors that must be assessed and weighed any and every time spectrum changes are contemplated. Such key factors include safety, technical compatibility, and the installed base of fielded equipment.

It goes without saying that spectrum utilized in safety-of-life services must be valued for more than the data throughput it provides. Any consideration of bands for the spectrum pipeline must take into account the need to protect and preserve safety-of-life services – both in the band(s) under consideration as well as spectrally proximate bands. Indeed, NTIA has already recognized the need to preserve safety services in comments filed in other proceedings.[5] Of particular concern are the nautical and aeronautical safety systems, services, and technologies on which mariners and aviators have come to rely over the years.

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[4] 88 FR 16245.

[5] *See generally* Comments of the National Telecommunications and Information Administration, Federal Communications Commission ("FCC") WT Docket No. 22-204 (July 29, 2022). NTIA lists particular services that must be protected in its response to the FCC Notice of Inquiry.

Marine safety has benefited greatly from very high frequency ("VHF") radio communications, navigation systems like GNSS, weather/navigation radar systems, marine automatic identification systems ("AIS"), emergency position indicating radio beacons ("EPIRB"), and the global maritime distress and safety system ("GMDSS"). Entry into the spectrum pipeline must preserve the utility of these safety services.[6]

Likewise, aviation safety has dramatically improved with the development of spectrum and technology to support ground and airborne surveillance and weather radars, VHF omni-directional ranging systems ("VOR"), instrument landing systems ("ILS"), the global positioning system ("GPS") and downstream technologies it enables like the terrain avoidance and warning system ("TAWS"), radio (radar) altimeters, as well as VHF and high frequency ("HF") communications.[7]

In addition to safety, the life cycle of fielded user equipment must be considered when evaluating spectrum for the pipeline. While cellular or other consumer electronics equipment might enjoy rapid replacement intervals of just a few years, equipment designed for high-end industrial applications and marine or aviation safety applications often sees life cycles measured in decades rather than years.[8] The replacement cost for such high-end systems is also significant. In addition to the cost of the equipment itself, the core technologies enabling these systems are often deeply embedded within other higher-level systems, leading to substantial and costly down-time for system upgrades and testing.

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[6] Other maritime safety services mentioned in 47 CFR Part 80 should also be considered.
[7] Other aviation safety services mentioned in 47 CFR Part 87 should also be considered.
[8] For example, first introduced 25 years ago in 1998, the Garmin GNS 430/530 aviation equipment series supports GNSS, VHF communications, VOR, and ILS functions in a single unit and became the most installed series of general aviation/business aviation equipment ever produced. Garmin recently announced that its ability to provide comprehensive repair services for the GNS 430/530 series is expected to become limited in the years ahead. *See* Garmin Service Advisory No. 23018 Rev A, (March 14, 2023) available at https://atlaske-content.garmin.com/filestorage/email/outbound/attachments/23018A_Time1678806159574.pdf.

Technical compatibility between new spectrum uses and incumbent uses must also be considered when evaluating spectrum for the pipeline. Adjacent spectrum uses with highly disparate power levels, for example, may simply be incompatible with one another. A national spectrum pipeline must not only note the availability of a particular block of spectrum, but also prescribe appropriate possible uses based on adjacent bands and services. Moreover, it must guarantee the availability of transmitter and receiver performance characteristics sufficient for regulatory bodies, expert agencies, and industry associations to perform a robust spectrum compatibility assessment.[9]

In summary, when considering spectrum for the pipeline, the protection and preservation of safety systems and services must remain paramount. Additionally, the life cycle of the installed base of fielded equipment in the band(s) under consideration, as well as adjacent bands, must be understood and quantified. Finally, sufficient transmitter and receiver performance characteristics must exist in order to allow the assessment of technical compatibility between new entrants and incumbent services.

B. Question 5: Spectrum access underpins cutting-edge technology that serves important national purposes and government missions. Are there changes the government should make to its current spectrum management processes to better promote important national goals in the short, medium, and long term without jeopardizing current government missions?

The tension between new technologies and current government missions will always exist. An effective NSS must be multi-faceted in its evaluation and prioritization of both new and incumbent spectrum uses. A NSS that prioritizes economic factors to the exclusion of safety and innovation, is short-sighted.[10] For example, a NSS that would allow the safe landing of aircraft to be jeopardized in

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[9] In the recent C-Band / Radar altimeter proceeding, aviation parties repeatedly struggled to garner participation from the cellular industry in a multi-stakeholder process designed to quantify interference to radar altimeters. Rather than participate, cellular industry groups actively avoided interaction and sought to undermine the process. *See* Organizations Supporting Aviation Safety Ex Parte in FCC WTB Docket No. 18-122 (11/19/21), pg. 3, available at https://www.fcc.gov/ecfs/document/105130442707885/1.

[10] Multiple measures may be necessary to assess and quantify the intensity of spectrum utilization by dissimilar services. Spectrum value must not be reduced to a statement of throughput or monetization. Factors such as safety and public

order to free up spectrum for streaming media would be myopic indeed.

Transition costs must also be taken into account – the government has an obligation to spend wisely the taxpayer resources entrusted to it. When there is a significant government investment in a particular technology or spectrum, especially in safety services like GNSS, ILS, and VOR, a comprehensive NSS must ensure that both the investment and the services that citizens have come to rely on are protected. This does not mean that incumbent services must be preserved indefinitely; rather, the safety and utility of a service must be carried on by an equivalent or superior service – something that takes careful planning of transition time and transition cost.[11] Moreover, if no such alternatives exist, the spectrum planning process must allow for the reality that certain incumbent spectrum allocations, especially those for safety-of-life services, should not be put at risk.

II. PILLAR #2—LONG-TERM SPECTRUM PLANNING

Garmin supports NTIA's efforts to put into place a long-term planning process characterized by openness and transparency. Taking the long-view on spectrum planning will help avoid the pitfalls experienced in recent years when a desire to rapidly deploy new services has overshadowed the careful and deliberate planning needed for thorough vetting of technical compatibility between new and incumbent services as well as optimization of transition plans and costs. Accordingly, Garmin offers comments in response to select questions from Pillar #2.

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utility should also be considered. Moreover, the price tag commercial operators are willing to pay for a particular swath of spectrum doesn't tell the entire story. NTIA must also consider overall business segment impact to gross domestic product ("GDP"). By way of example, "[w]hile the telecoms industry pays huge sums for its use of spectrum compared to aviation and is a spectrum competitor, nevertheless both industries are comparable in importance to global GDP (€3.6 trillion & €3.1 trillion, or 4.7% [&] 4.1% respectively), serving similar numbers of users (5.2 billion subscribers, 4.5 billion passengers)" (*see,* EUROCONTROL Think Paper 17, Key Finding #4 available at https://www.eurocontrol.int/publication/eurocontrol-think-paper-17-why-aviation-urgently-needs-improve-its-use-radio-spectrum).

[11] For example, the gradual movement of aviation VOR from primary to backup means of navigation has been predicated on the availability and adoption of a superior technology – GPS/GNSS. *See* the FAA Notice about the transition of VOR from primary service to backup means of navigation, available at https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gbng/vormon. The timeline at the bottom of that page indicates the VOR Minimum Operational Network (VOR MON) program started phasing out VORs in FY2016 with projected completion in FY2030.

A. Question 1: Who are the groups or categories of affected stakeholders with interests in the development of the National Spectrum Strategy and participating in a long-term spectrum-planning process?

It is critical to ensure that all stakeholders have an opportunity to participate in the long-term spectrum planning process. This provision will facilitate transparency to the greatest extent possible and ensure efficient and effective use of the nation's spectrum resources. Garmin recommends that the following categories of stakeholders for bands under consideration as well as for adjacent bands be included in the spectrum planning process.

- Equipment manufacturers (e.g., Garmin)
- OEMs (e.g., integrators of marine, aircraft, or other equipment)
- Manufacturing/industry organizations (e.g., manufacturing organizations like GPS Innovation Alliance, General Aviation Manufacturers Association, National Association of Manufacturers, Aerospace Industries Association, and National Marine Manufacturers Association as these organizations could ensure their members are notified of potential spectrum changes and aggregate the impacts from their members)
- Standards development organizations (e.g., RTCA, Radio Technical Commission for Maritime Services, and National Marine Electronics Association)
- Users groups (e.g., National Business Aviation Association, Air Line Pilots Association, International, Boat U.S., etc.)

B. Question 2. What type of timeline would be defined as a ''long-term'' process?

Various factors must be considered when assessing an appropriate timeline for a long-term process. Most obviously, the life-cycle of equipment in the band under consideration, as well as adjacent bands, must be taken into account.[12] Additionally, test and certification requirements for new or incumbent user equipment as well as the systems into which that equipment is integrated must be factored into the timeline and process.[13]

Another factor affecting the process timeline is the availability of the transmitter and receiver performance characteristics of both new and incumbent services needed to perform a technical

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[12] *See also* comments on Pillar 1, Question 4.

[13] For example, certified aviation equipment undergoes traditional FCC type certification in addition to more rigorous FAA certification of both the aviation equipment itself (Technical Standard Order) as well as the installation in a particular aircraft (Type Certification/Supplemental Type Certification).

spectrum compatibility assessment.[14] In particular, transmit characteristics for in-band and out-of-band emissions, antenna location and positioning, as well as duty-cycle and density of the service are critical to understanding interference potential.[15] Similarly, receiver characteristics are also a necessary component in any such evaluation, especially parameters for incumbent equipment that define necessary safety or performance levels.[16]

Acquiring accurate information on transmitter and receiver characteristics for new and incumbent services in shared and adjacent spectrum is often a lengthy and contested process.[17] While information from standards development organizations ("SDOs") can sometimes be a good starting point, it is often insufficient to perform a comprehensive spectrum compatibility assessment. In Garmin's experience, issues often arise around proprietary services or those so new that many technical parameters have yet to be defined. A long-term process must allow sufficient time to investigate, gather and define system parameters and characteristics needed to conduct a thorough technical compatibility assessment prior to any consideration of spectrum reallocation – and the integrity of the process demands that a determinization of "incompatible" be a viable outcome of the process.

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[14] *See further* comments on Pillar 1, Question 4.

[15] Specific transmit parameters such as antenna deployment height, gain/radiation pattern, down-tilt, and polarization are needed, along with in-band transmission characteristics of the signal (e.g., power, frequency, bandwidth, modulation/data-rate, roll-off/filtering), out-of-band characteristics (e.g., harmonic filtering, spurious emissions).

[16] Receiver characteristics such as sensitivity, noise figure, selectivity and compression point are important in characterizing any receiving system. Also needed for combability analysis are appropriate system-level performance indicators (e.g., Signal to Noise Ratio ("SNR"), Carrier to Noise power density ratio ("C/N_0"), Energy per bit to Noise power spectral density ratio E_b/N_0, etc.) along with established interference protection criteria ("IPC") unique to each service.

[17] Even when such information is readily available, it is often contested – especially by new entrants motivated to monetize and deploy spectrum rapidly. *See, e.g.*, the U.S. Department of Transportation's ("DOT") GPS Adjacent Band Compatibility assessment where an IPC of a 1 dB reduction in C/N_0 is clearly defined (available at https://www.transportation.gov/pnt/global-positioning-system-gps-adjacent-band-compatibility-assessment). Parties interested in monetizing adjacent spectrum have sought to undermine this IPC for years, requiring an act of Congress and detailed study by the National Academies of Science, Engineering, and Medicine ("NASEM") to uphold the utility of SNR-based IPCs for protection of GPS/GNSS spectrum (*see* https://nap.nationalacademies.org/catalog/26611/analysis-of-potential-interference-issues-related-to-fcc-order-20-48).

C. Question 4. What technical and policy-focused activities can the U.S. Government implement that will foster trust among spectrum stakeholders and help drive consensus among all parties regarding spectrum allocation decisions?

NTIA is wise to recognize the need to foster trust among spectrum stakeholders and to seek consensus. At times, entities within the U.S. government ("USG") have been perceived as valuing the commercial potential of spectrum for terrestrial broadband use above all other factors. This perception has created a trust deficit within certain industries, and transparency is needed to help combat this; specifically, a NSS should openly disclose the priorities and values of regulators when it comes to weighing the spectrum requirements of new technologies with incumbent technologies.[18] Explicit recognition of the value of safety-of-life spectrum and services, in addition to valuing innovation and economic factors, would go a long way toward establishing trust. Additionally, establishing a mechanism or process to solicit and actively consider the technical concerns of existing equipment manufacturers, user communities, and government stakeholders would also help promote trust and collaboration.

D. Question 5. Are additional spectrum-focused engagements beyond those already established today (e.g., FCC's Technical Advisory Committee (TAC), NTIA's Commerce Spectrum Management Advisory Committee (CSMAC), and NTIA's annual Spectrum Policy Symposium) needed to improve trust, transparency, and communication among the federal government, industry, and other stakeholders (including Tribal Nations) and why?

There may be benefit in establishing new, additional spectrum-focused committees; however, a first step in improving trust, transparency, and communication would be to overhaul and broaden the scope of existing committees. While spectrum technology use and utilization are quite broad, many of the committees mentioned are narrow in scope and captive to the telecom industry.[19] If existing committees were to broaden their scope beyond telecom and likewise broaden their

[18] Garmin appreciates the role NTIA has played in aggregating feedback from various expert USG agencies in past spectrum proceedings and thinks NTIA is uniquely positioned to foster open discussion of USG priorities and values in the NSS.

[19] *See also* Pillar 2, Question 4.

membership to include a statistically significant percentage of non-telecom participants, trust and transparency would likely be improved.

Additionally, Garmin notes that NTIA's participation in aviation committees convened to study spectrum issues has been welcomed by the aviation industry.[20] Going forward, NTIA should consider participating in other spectrum-related committees convened by RTCA and other SDOs. For example, RTCA initiated Special Committee 242 ("SC-242") in March 2022 to develop a guidance document to be used when implementing aviation RF system standards to ensure their spectral efficiency.[21] This effort may be the first by an industry to implement a dedicated publication for the design and implementation of RF performance standards for systems in a global spectrum environment. Garmin, and the aviation industry, would welcome NTIA's, and the FCC's, participation on SC-242 to ensure that this guidance meets the goals of NTIA and other USG agencies in the NSS.

E. Question 6. In considering spectrum authorization broadly (i.e., to include both licensed and unlicensed models as well as federal frequency assignments), what approaches (e.g., rationalization of spectrum bands or so-called ''neighborhoods'') may optimize the effectiveness of U.S. spectrum allocations?

The creation and maintenance of spectrum bands or neighborhoods is a sound approach to spectrum management. Engineers and regulators have long recognized that certain bands and frequencies are well-suited to particular applications based on signal transmission and propagation characteristics. Extremely low frequencies may travel long distances but are difficult to integrate into handheld devices. Some frequencies reflect well off the ionosphere while others penetrate it. Some bands (e.g., the Mobile Satellite Service L-band) are well-suited to space-to-earth or earth-to-space transmissions while others work well for surveillance or weather radar.

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[20] NTIA participation in RTCA's Special Committee 239 ("SC-239") Low Range Radar Altimeter committee is helpful and welcomed by the industry.

[21] *See* SC-242, Spectrum Compatibility at https://www.rtca.org/sc-242/. Note particularly the related *Terms of Reference* available on that page.

Grouping similar or compatible technologies and services into spectrum neighborhoods fosters innovation and creates opportunities for more rapid deployment of new, similar services. Likewise, a neighborhoods approach recognizes critical differences between communication and navigation technologies and provides space for each to function without interference.

In considering appropriate allocations for different spectrum neighborhoods, the NSS should take a number of factors into account. First, as a matter of policy, it should avoid introducing high-powered services into low-power spectrum neighborhoods. Further, as mentioned already, it should consider factors such as service type (e.g., safety-of-life), equipment life cycle, and equipment certification requirements by other USG agencies.[22] Finally, service-specific, industry-standard interference protection criteria must be applied consistently in order to provide continuity and reliability of service in given spectrum neighborhoods.[23]

III. IMPLEMENTATION PLAN

A. What specific steps should be included in the Implementation Plan that could be taken in the next 12–24 months to ensure the successful execution of the National Spectrum Strategy?

Successful execution of the NSS will hinge on buy-in from government and industry stakeholders. Key will be the ability of NTIA to balance the needs of incumbents and new entrants while preserving the utility of existing safety-of-life services. The NTIA, in collaboration with the FCC and in coordination with its other federal partners, will also have to work hard to convince incumbents that NSS implementation will show equal fidelity and consideration to all parties, incumbents and telecommunications entities alike. With transparency and good-faith efforts to fairly treat incumbent equipment manufacturers with significant investments in research and development

[22] *See* Pillar 2, Question 4. Such precautions would help avoid repeating past spectrum management issues where FCC rulemaking has gone against the recommendations of other expert agencies like the NTIA, Department of Defense, DOT, and FAA.

[23] For example, the industry-wide standard IPC for GNSS receivers is a 1 dB reduction in C/N_0. *See further* comments on IPCs from the U.S. Department of Transportation at *supra* note 17.

and certification testing as well as incumbent users who depend on spectrum and services for safety-of-life, NTIA will have a reasonable hope of implementing the NSS.

IV. CONCLUSION

Garmin appreciates the opportunity to provide comments to NTIA and encourages it to continue forward in a spirit of cooperation and collaboration with other expert agencies and industry stakeholders in the development of the NSS. In order to achieve full utility and broad consensus, the NSS should consider factors such as safety-of-life, technical compatibility, and the installed base of fielded user equipment in addition to important economic factors. It must also preserve spectrum neighborhoods and recognize critical differences between communication and navigation systems, allowing each to function without interference as defined by appropriate, service-specific interference protection criteria.

Respectfully submitted,

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