BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matter of	
Use of Spectrum Bands Above 24 GHz for Mobile Radio Services	GN Docket No. 14-177
Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands	IB Docket No. 15-256
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 to Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services	WT Docket No. 10-112
Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations	IB Docket No. 97-95

COMMENTS OF IRIDIUM COMMUNICATIONS, INC.

INTRODUCTION

Iridium Communications, Inc. ("Iridium") operates the largest and most ambitious satellite constellation ever launched: a non-geostationary orbit (NGSO) system of sixty-six satellites that function as a fully meshed network in outer space. Its network is the only one that reaches everyplace on the surface of the earth, and provides reliable and exceptionally low-latency voice, data, and machine-to-machine connectivity. Because of its unique capabilities, the Iridium network continues to provide mission-critical services to the U.S. military, national security agencies, and countless U.S. industrial leaders almost twenty years after its launch. And as these words are being written, the capabilities of the Iridium network are on the cusp of a dramatic expansion with the ongoing launch of Iridium NEXT, the company's $3 billion second-

generation satellite constellation. With forty Iridium NEXT satellites already in orbit, Iridium will be able to provide high-speed broadband to a new generation of warriors, rescuers, explorers, adventurers, passengers, pilots, boaters, and truckers in ways that other networks simply cannot.

Iridium submits these comments to reiterate that its network cannot function without reliable access to the 29.1-29.25 GHz band, to which Iridium has had co-primary rights for feeder links since its first satellite was launched. Recognizing Iridium's critical and primary operations, the Commission has rejected squarely and repeatedly calls to authorize terrestrial mobile services in the band—including in its order on reconsideration released last November.[1] Terrestrial networks are no worse off as a result of the Commission's decisions, because there is no good case for using the 29.1-29.25 GHz band for a terrestrial mobile 5G network. Accordingly, just as it has done at each step of this proceeding, the Commission should decline to authorize terrestrial mobile services in the 29.1-29.25 GHz band.

ARGUMENT

In the *SFNPRM*, the Commission sought comment on whether additional bands raised "in the prior *NPRM/FNPRM* or raised in the record" should be made available for flexible use services in light of "new studies or quantitative data."[2] As an initial matter, the 29.1-29.25 GHz

---

1 *See Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, FCC 17-152 ¶ 269 & Exhibit E (2017) ("*SFNPRM*") (summarily denying petitions for reconsideration, including Nextlink Wireless, LLC's request to authorize flexible terrestrial mobile services in the 29.1-29.25 GHz band). *See also Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd. 8014, 8145 ¶ 373 (2016) ("*FNPRM*") (declining to propose flexible terrestrial use of the 29.1-29.25 GHz band); *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, Notice of Proposed Rulemaking, 30 FCC Rcd. 11,878, 11,902 ¶ 70 (2015) ("*NPRM*") (declining to propose flexible use licensing of the 29.1-29.25 GHz band because Iridium operates in the band with "co-primary status").

2 *SFNPRM* ¶ 109.

band does not meet the *SFNPRM*'s criteria for additional bands that will remain under consideration if new studies or data prove sufficiently convincing. Neither the *NPRM* nor the *FNPRM* proposed the 29.1-29.25 GHz band as a flexible use candidate,[3] and the record scarcely discusses how coexistence between NGSO and terrestrial mobile systems might work operationally. Moreover, the Commission rejected a request to open the 29.1-29.25 GHz band to flexible use services *in the very same item*.[4]

Nevertheless, out of an abundance of caution, Iridium reiterates that the Commission's reasons for rejecting the 29.1-29.25 GHz band for terrestrial mobile use remain just as sound today as they were about seventy days ago. The benefit of using the band for next-generation terrestrial systems is *exceedingly* small, while the risk to Iridium, its customers (including the U.S. military and other government users), and planned NGSO MSS systems is enormous.

I. The 29.1-29.25 GHz Band is Too Small, Too Isolated, and Too Irregular to Be Useful for Next-Generation Terrestrial Networks.

No one seriously disputes that terrestrial networks will need large amounts of contiguous bandwidth to deliver the ultra-fast broadband expected of next-generation systems.[5] Yet at just 150 MHz wide, the 29.1-29.25 GHz band has nowhere near the 500 MHz previously suggested

---

3 *See NPRM* ¶ 70; *FNPRM* ¶ 373.

4 *SFNRPM* ¶ 269 & Exhibit E.

5 *See, e.g.*, Comments of CTIA at 13, GN Docket Nos. 14-177 *et al.* (filed Sept. 30, 2016) ("access to these kinds of large contiguous blocks of spectrum"—*i.e.*, blocks as wide as "5.5 gigahertz"—"will be key to leveraging the millimeter wave bands in support of 5G systems"); Comments of the Telecommunications Industry Association at 5, 10-12, GN Docket Nos. 14-177 *et al.* (filed Sept. 30, 2016); Comments of AT&T at 7, 9-10, GN Docket No. 14-177 *et al.* (filed Sept. 30, 2016) ("AT&T Sept. 2016 Comments"); Comments of Verizon at 6-7, 13-15, GN Docket Nos. 14-177 *et al*. (filed Jan. 28, 2016); Reply Comments of AT&T at 8, GN Docket Nos. 14-177 *et al.* (filed Feb. 26, 2016); Comments of Qualcomm Incorporated at I, GN Docket Nos. 14-177 *et al*. (filed Jan. 27, 2016); Comments of Huawei Technologies, Inc. (USA) and Huawei Technologies Co., LTD. at 5-6, GN Docket Nos. 14-177 *et al*. (filed Jan. 28, 2016); Letter from Charla Rath, Vice President, Wireless Policy Development, Verizon, to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 14-177 (filed Jul. 7, 2016).

as a minimum for flexible use bands,[6] and is even smaller than the 200 MHz minimum channel widths commonly suggested by terrestrial operators themselves.[7] Importantly, the 29.1-29.25 GHz band is also isolated; none of the spectrum adjacent to it has been proposed for flexible use by *anybody*. As a result, flexible use terrestrial licensees in the 29.1-29.25 GHz band would be unable to bond channels to achieve the bandwidths required to deliver ultra-fast 5G services.

Even assuming that 150 MHz of millimeter-wave bandwidth were enough for some next-generation terrestrial use, flexible use spectrum in the 29.1-29.25 GHz band would remain perpetually unpaired. This is because there are no 150 MHz-sized flexible use channels located anywhere *near* the 29.1-29.25 GHz band. Nor could a 29.1-29.25 GHz licensee use carrier aggregation to assemble larger paired blocks in combination with other flexible use spectrum. As an initial matter, under the 24 GHz and 28 GHz band plans already adopted by the Commission, there are few combinations that a 24 GHz or 28 GHz licensee realistically could pursue that would leverage 29.1-29.25 GHz frequencies without also wasting significant amounts of licensed bandwidth. Moreover, spectrum in those lower frequencies is unlikely to be fungible with spectrum in the 29.1-29.25 GHz band in any event. And even if these hurdles are overcome, the extreme inefficiencies of carrier aggregation in high-frequency spectrum would limit any benefit to terrestrial networks as a practical matter.[8]

---

6 *See NPRM* ¶ 70.

7 *See, e.g.*, Reply Comments of CTIA at 12-13, GN Docket Nos. 14-177 *et al*. (filed Feb. 26, 2016); Letter from Charla Rath, Vice President, Wireless Policy Development, Verizon, to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 14-177 (filed Mar. 16, 2016); *see also* Verizon Comments at 7; Comments of AT&T at 12-14, GN Docket Nos. 14-177 *et al*. (filed Jan. 28, 2016).

8 *See* AT&T 2016 Comments at 7, 10 (explaining that aggregation in millimeter wave frequencies "would come at a cost in terms of power consumption, equipment complexity, and system performance").

That probably explains why the single terrestrial mobile use case articulated for this spectrum has been as unpaired supplemental downlink capacity.[9] But the idea that 150 MHz of one-way bandwidth will be needed or noticed in a 5G environment is fanciful, especially given the inefficiencies of carrier aggregation in the millimeter wave bands. And the availability of one-way bandwidth *surely* will not be noticed when it comes to wireless competition, because a facilities-based carrier cannot possibly use an unpairable supplemental downlink channel to enter a market as a new competitor. Finally, there are no indications that the standards development process has even begun to explore using irregular, 150 MHz-sized blocks for *any* purpose at all.

Iridium understands that in some cases, it may be sensible for the Commission to look to smaller blocks of millimeter wave spectrum for terrestrial mobile use. This is just not one of those cases. As explained, meager and highly inefficient supplemental downlink capacity remains the band's best possible use for terrestrial 5G. Moreover, because the ITU has not designated the 29.1-29.25 GHz band for consideration as an IMT 2020 (5G) candidate,[10] this spectrum cannot be harmonized internationally, which further diminishes its utility to terrestrial carriers.

These characteristics sharply distinguish the 29.1-29.25 GHz band from the 24 GHz band, where the Commission ultimately decided to authorize flexible use services using channel sizes narrower than 200 MHz.[11] Adopting 5x100 MHz channelization, the Commission

---

9 Comments of Nextlink Wireless, LLC at 11-12, GN Docket Nos. 14-177 *et al*. (filed Sept. 30, 2016).

10 *See* World Radiocommunication Conference, Final Acts, Resolution 238 (WRC-15) (2015) *available at* https://www.itu.int/dms_pub/itu-r/oth/0c/0a/R0C0A00000C0014PDFE.pdf (declining to identify the 29.1-29.25 GHz band as even a candidate band for IMT-2020). *See also* Reply Comments of Iridium Communications, Inc. at 6-7, GN Docket Nos. 14-177 *et al*. (filed Oct. 31, 2016) (explaining that "the prospect of harmonized use of the [29.1-29.25 GHz band] for 5G operations has evaporated"); Reply Comments of Iridium Communications, Inc. at 3, GN Docket Nos. 14-177 *et al*. (filed Feb. 26, 2016) ("the recent World Radiocommunication Conference declined to even study the 29.1-29.25 GHz band for terrestrial mobile services.")

11 *SFNPRM* ¶¶ 15-35.

observed that "standardized channels across the band" would "allow licensees to aggregate to larger channels if they prefer 200 megahertz blocks"[12]—an opportunity that is not available to 29.1-29.25 GHz licensees for the reasons discussed above. The Commission also acknowledged that the ITU has identified the 24 GHz band as an IMT candidate,[13] which, again, is not true of the 29.1-29.25 GHz band. Finally, the Commission's principal reason for pursuing 100 MHz channels in the 24 GHz band was to expand "the number of potential entrants to the band"—something that an isolated and irregularly sized one-way channel cannot do. In short, the Commission's adoption of 100 MHz channels to maximize flexibility in an IMT candidate band with more than *three times* (500 MHz) the available bandwidth hardly warrants revisiting its conclusions about the 29.1-29.25 GHz band. To the contrary, the differences between the 24 GHz and 29.1-29.25 GHz band only underscore why the Commission should continue to focus on other, more suitable bands for terrestrial mobile services.

II. The 29.1-29.25 GHz Band Raises Unique Sharing Challenges Not Present in Other Flexible Use Spectrum.

The Commission has, of course, authorized flexible use services in several bands shared with satellite services. None of those bands, however, have required sharing between flexible use licensees and large, co-primary NGSO satellite systems that operate in low-Earth orbit. The low orbital altitude, large size, and NGSO architecture are precisely what make Iridium's network an indispensable element of global telecommunications infrastructure. But as explained below, these characteristics also pose unique and likely insurmountable hurdles to sharing the 29.1-29.25 GHz band with ubiquitously deployed terrestrial mobile services.

---

[12] *Id.* ¶ 35.

[13] *Id.* ¶ 22. *See also FNPRM* ¶¶ 372-373.

Iridium uses the 29.1-29.25 GHz band for feeder-link and telemetry, track and control communications in the earth-to-space direction. Iridium has been able to share this spectrum successfully with the LMDS, a fixed terrestrial service that is not widely deployed. As Iridium previously explained, however,[14] ubiquitous terrestrial mobile deployments would upset that balance significantly. Iridium would face enormous risks of harmful interference, as would terrestrial mobile operators.

For Iridium, a large number of terrestrial mobile devices transmitting at a relatively high power would produce aggregate interference at Iridium satellite receive antenna. These emissions are much more likely to interfere harmfully with Iridium's NGSO low-Earth-orbit system than with satellite systems that operate in other flexible use spectrum. First, ***at an orbital altitude of roughly 480 miles, Iridium's satellites are nearly 45 times closer to the Earth's surface than GSO satellites, and more than 10 times closer than NGSO systems in medium-Earth-orbit that operate in the 28 GHz band***. As a result, the received power of interfering signals from terrestrial mobile devices would be much higher at the Iridium satellite receive antenna than they would be at satellites that are not in low-Earth orbit. Moreover, to communicate with Iridium's large satellite constellation, Iridium's feeder-link earth stations use steerable antennas that sweep from side to side at all azimuth angles and up and down at elevation angles down to 5°—in other words, through all regions of the sky from 5° above the horizon. That is not the case for earth station transmit antennas that communicate with GSO satellites, which point in one direction toward one satellite. As a result, a much larger number of

[14] *See, e.g.*, Comments of Iridium at 4-6, GN Docket Nos. 14-177 *et al*. (Jan. 27, 2016); Letter from Scott Blake Harris, Counsel, Iridium Communications, Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket Nos. 14-177 *et al*. (filed May 18, 2016); Letter from Scott Blake Harris, Counsel, Iridium Communications, Inc., to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket Nos. 14-177 *et al*. (filed Jul. 8, 2016).

terrestrial mobile devices operating in a much larger area around an Iridium earth station would contribute to the aggregate interference problem.

The dynamic link geometry of the Iridium network also creates a much greater risk of interference into terrestrial mobile systems—a risk that would have to be tolerated given Iridium's co-primary status and priority. Unlike GSO earth stations, Iridium feeder-link earth stations must transmit at very low elevation angles. As a result, Iridium earth-to-space transmissions are more likely to interfere with the receive antennas of terrestrial mobile base stations. And because Iridium feeder-link earth stations transmit at all azimuths, affected mobile base stations could be located anywhere around the Iridium earth station.

Iridium is not the only party that has brought these unique challenges to the Commission's attention. Earlier in this proceeding, Intel acknowledged that the 29.1-29.25 GHz band raised "particularly challenging interference scenarios" for terrestrial 5G networks.[15] Along the same lines, SpaceX observed that

> . . . in satellite uplink bands there are potential challenges to sharing between intensive, high-power terrestrial operations and satellite services. Not only do satellite earth station uplink operations have the potential to cause interference into terrestrial receive antennas, but aggregate interference from terrestrial operations could adversely impact satellite receive operations. *These effects are particularly important to consider in the context of NGSO operations, where steerable earth station transmit antennas would have a wider geographic impact and significantly lower satellite altitudes magnify the impact of aggregate interference from terrestrial transmissions.* While spectrum sharing between some terrestrial and satellite operations remains possible in appropriate circumstances, the Commission should remain cognizant of technical and operational differences between services that may effectively limit sharing opportunities.[16]

---

[15] Letter from Dave Horne, Global Public Policy Group, Intel Corporation, to Marlene H. Dortch, Secretary, Federal Communications Commission, at Attachment 1 p. 12-13, GN Docket No. 14-177 (Aug. 10, 2015).

[16] Reply Comments of Space Exploration Technologies Corp. at 6, GN Docket No. 14-177 et al. (Feb. 18, 2015).

The practical result of these difficult interference scenarios is that, even assuming sharing were possible, terrestrial operators using the 29.1-29.25 GHz band would have to observe massive zones of exclusion around Iridium feeder-link earth stations, both to protect Iridium's network and their own operations. Those zones of exclusion would grow even larger as Iridium expands its ground infrastructure to meet demand for Iridium NEXT. Thus, the already limited practical utility of the 29.1-29.25 GHz band for terrestrial mobile services would diminish even further once efforts to manage interference are properly taken into account.

CONCLUSION

The Commission should remain steadfast in its determination that the 29.1-29.25 GHz band remains poorly suited to terrestrial flexible use services.

Respectfully submitted,

Scott Blake Harris
V. Shiva Goel
HARRIS, WILTSHIRE & GRANNIS LLP
1919 M Street, Eighth Floor
Washington, DC 20036
(202) 730-1300
Counsel to Iridium Communications, Inc.

Maureen C. McLaughlin
Vice President Public Policy
IRIDIUM COMMUNICATIONS, INC.
1750 Tysons Boulevard, Suite 1400
McLean, VA 22102
(703) 287-7518

January 23, 2018