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
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band	RM-11664
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 INMARSAT MOBILE NETWORKS, INC.

Table of Contents

EXECUTIVE SUMMARY

Thirty-one years ago this month, Inmarsat launched the world's first global mobile satellite communications system, providing merchant ships and U.S. naval vessels with access to telephone and telex networks as they traversed the three oceans. More than a decade ago, Inmarsat began commercial operation of its Broadband Global Area Network, a mobile satellite system supporting a number of IP-based services all over the world. And just last month, Inmarsat began worldwide operation of its new Global Xpress network, a Ka-band satellite service capable of bringing broadband connectivity at speeds of up to 50 Mbps to nearly any location in the air, on land, and at sea.

With Global Xpress and the innovative constellations that preceded it, Inmarsat has extended advancements in telecommunications to the most remote and inaccessible parts of the world and to customers, including the U.S. government, with the most stringent standards for security and reliability. Inmarsat looks forward to fulfilling the same function for next generation mobile broadband technologies and the innovative applications they support. Indeed, there is already considerable momentum behind the development of 5G as an integrated standard supporting the seamless delivery of services across both terrestrial and satellite networks. After all, to meet the promise of a global telecommunications revolution, new networks cannot be here or there. They must be everywhere—and that means Inmarsat must be involved.

Inmarsat remains concerned, however, that the Commission's proposed rule changes in the 28 GHz, 37 GHz, and 39 GHz bands[1] will deprive its constellation of the spectrum it needs to provide, expand, and enhance its services. If adopted without change, these draft rules would

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[1] *See Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, GN Docket No. 14-177, et al., Notice of Proposed Rulemaking, FCC 15-138, 30 FCC Rcd. 11,878 (2015) ("NPRM").

place at risk mission-critical communications that support aid organizations, critical sectors of the global economy, and the U.S. military. They would frustrate billions of dollars of investment capital sunk into advanced satellite networks, including Global Xpress, and threaten continued innovation in satellite services in the United States and across the globe. And they would hinder new networks—including the terrestrial broadband networks and the Internet-of-Things ("IoT") the Commission wishes to promote—from realizing the full potential made possible by heterogeneous solutions that capitalize on the coverage, reliability, and security only satellite networks can provide. Simply put, the Commission's vision for future 5G networks has been too constricted, in effect limiting those networks to cities and suburbs. This is one reason its vision has so far been rejected by the international community.

A broader, more balanced, and more nuanced approach will extend 5G services to more people and places – and receive far wider acceptance. For satellite operators, for their customers, and for users of new terrestrial services alike, Inmarsat urges the Commission to chart a more nuanced and balanced course in this proceeding.

I. Inmarsat's Services Are Critical to the Public – and to 5G.

As the largest mobile satellite operator in the world, Inmarsat provides critical services to the maritime and aviation communities, the energy, mining, construction, and transportation industries, military and civilian government agencies, and others that require access to ubiquitous, reliable, and secure communications. These services include broadband to ships and planes, transportation safety services, secure battlefield communications, and machine-to-machine communications that allow customers to monitor and manage infrastructure and equipment all across the world.

In response to exploding worldwide demand for bandwidth, Inmarsat recently launched three high-throughput Inmarsat-5 ("I-5") satellites to deliver Global Xpress, a Ka-band satellite

service that began worldwide operations in December 2015. Each I-5 satellite is equipped with 89 fixed beams and six high-capacity steerable beams, which allow the constellation to deliver broadband services with global coverage at speeds of up to 50Mbps and to direct additional capacity when and where it is needed most. Gateway operations for I-5 satellites are performed at a recently constructed gateway earth station located in Lino Lakes, MN, which uses Ka-band spectrum, including the 27.5-28.35 GHz (the "28 GHz band") for uplink transmissions. *Backed by a $1.5-billion-dollar investment, Global Xpress will transform inflight and maritime broadband connectivity, strengthen U.S. military capabilities, and support more sophisticated border control, counter-terrorism, and aviation security operations.*

By providing direct broadband service to more end-users, systems like Global Xpress increase the value of all networks, both terrestrial and space-based. But satellite networks serve an even more explicit role in expanding the potential of terrestrial networks. By supplying high-bandwidth backhaul to remote environments, fixed satellite services allow terrestrial networks to widen their reach. The most advanced terrestrial system imaginable will not reach a ship at sea or a soldier in the field without a satellite network connection. Moreover, through offloading, satellite networks increase the capacity of terrestrial networks. And when terrestrial networks become overloaded or compromised by storm, earthquake, or man-made disaster, satellite networks inevitably step in as a last line of communications.

Looking ahead to 5G—a technology for both "people and things"[2]—the availability of satellite networks will prove more fundamental. Developers of terrestrial 5G technology dare us

[2] *See* Letter from Brian Hendricks, Head of Technology Policy and Government Relations, Nokia, to Marlene H. Dortch, Secretary, FCC, at attachment p. 8, GN Docket No. 14-177, et al. (filed Aug. 26, 2015).

to imagine "massive machine communication"[3] over networks connecting "100 billion" things,[4] and widespread adoption of IoT applications including "smart metering,"[5] "smart sensors,"[6] "vehicular connectivity,"[7] and "mission-critical machine control and monitoring."[8] Inmarsat shares this vision, but with a much wider lens.

Inmarsat does not believe that smart meters should only serve cities with fiber facilities. Or that smart cities should go dim when disaster strikes. Or that networked, driverless cars should pull over if a tower fumbles the hand off. Or that vessels and aircraft cannot benefit from the same connectivity. Or that "mission-critical" machine control should be available only when equipment is conveniently located. Users will access Global Xpress services through versatile, compact, and easy-to-use terminals that can bring connectivity to devices, cars, trucks, ships, planes, and other equipment, manned or unmanned. And critically, these terminals can deliver IoT applications to nearly any location in the world and provide seamless end-to-end connectivity when integrated with terrestrial carrier services.[9]

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3 *Id.*

4 Comments of Huawei Technologies, Inc., and Huawei Technologies, Ltd. at Appendix 1 p. 8, GN Docket No. 14-177, et al. (filed Jan. 15, 2015) ("Huawei Comments").

5 Letter from Jeffrey A. Marks, Senior Counsel for Regulatory Affairs, Alcatel-Lucent, to Marlene H. Dortch, Secretary, FCC, at attachment p. 4, GN Docket No. 14-177, et al. (filed May 11, 2015).

6 Huawei Comments at Appendix 1 p. 3.

7 *Id.*

8 Comments of Intel Corporation at 8, GN Docket No. 14-177, et al. (filed Jan. 15, 2015).

9 *See* Caleb Henry, "Ericsson and Inmarsat Partner on Connected Ship Products," SatelliteToday.Com (Nov. 19, 2015), http://www.satellitetoday.com/telecom/2015/11/19/ericsson-and-inmarsat-partner-on-connected-ship-products/ (announcing a partnership to provide "an end-to-end managed cloud solution that connects vessels at sea to shore-based operations including maintenance service providers, customer support centers, fleet/transportation partners, port operations and authorities" by combining Global Xpress with Ericsson's maritime cloud services).

II. A Nuanced and Balanced Approach is Necessary in 5G Bands.

Outside the United States, regulators and terrestrial carriers alike have recognized that heterogeneous networks leveraging satellite technology will play a critical role in the delivery of 5G. Under the Commission's current proposal for the 28 GHz, 37 GHz, and 39 GHz bands, however, that role remains unlikely to develop to the detriment of consumers and the 5G ecosystem.

A. The 28 GHz Band

The Commission proposes to allow terrestrial 5G services to enter the 28 GHz band by obtaining a license to operate an Upper Microwave Flexible Use Service ("FUS"). To assign FUS licenses, the Commission plans to hold a series of auctions and rely on transactions on the secondary market. Incumbent primary licensees—specifically, holders of an active Local Multipoint Distribution Service ("LMDS") license—would receive an FUS license by rule before the auction takes place.[10]

In the NPRM, the Commission recognized that numerous FSS gateway earth stations are currently licensed to operate in the 28 GHz band on a secondary basis with respect to LMDS.[11] The Commission also recognized that satellite operators need guarantees that these "earth station[s] would not have to shut down" if new terrestrial services enter the 28 GHz band.[12] Nevertheless, the Commission oddly (and disastrously) declined to allow FSS earth stations to operate on a co-primary basis with respect to new FUS systems.[13] Instead, the Commission determined that FSS operators must purchase an FUS license to obtain the right to operate on a

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10 NPRM, 30 FCC Rcd. at 11,907-08 ¶¶ 93-95.

11 *Id.*

12 *Id.* at 11,920 ¶ 139.

13 *Id.* at 11,892 ¶ 130.

protected basis, with some exceptions. The Commission proposed to allow earth stations that are "in operation and providing service" from outside an LMDS license area to obtain flexible use rights by rule.[14] Earth stations located outside an LMDS license area that are not "in operation and providing service," but for which the operator files an application for authorization prior to auction, would be eligible for a waiver of secondary status if the operator proves to the Commission's satisfaction that the facility is unlikely to obstruct terrestrial deployments.[15]

These rules would frustrate Inmarsat's $1.5 billion investment in its Global Xpress system. Global Xpress interfaces with terrestrial networks though a gateway earth station located in Lino Lakes, MN, within the territory of an LMDS licensee. As a result, Inmarsat would not be eligible to obtain terrestrial rights for this facility except through the FUS license auction and by negotiating with the LMDS licensee directly. Yet Inmarsat has already negotiated an agreement to avoid interfering with the incumbent's existing services. And Inmarsat obtained authorization to commence operations at Lino Lakes just last year, less than seven months before the Commission issued its NPRM.[16] Inmarsat planned, designed, and constructed the facility well before the FCC released its order of authorization. And it did so on the basis that the facility would have to operate subordinate to a fixed, point-to-multipoint service—not ubiquitously deployed mobile broadband services.

If mobile services enter this spectrum, their demands for interference protection may force Inmarsat's recently constructed earth station to "shut down."[17] This outcome would disrupt

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14 *Id.* at 11,920-21 ¶¶ 140-141.

15 *Id.* at 11,921 ¶¶ 143-145.

16 *See Inmarsat Mobile Networks, Inc.: Application to Operate a Fixed-Satellite Service Gateway Earth Station Facility in Lino Lakes, Minnesota with the Imarsat-5 F2 Space Station*, Order and Authorization and Declaratory Ruling, DA 15-392, 30 FCC Rcd. 2770 (Int'l Bureau & Office of Eng'g and Tech. 2015).

17 NPRM, 30 FCC Rcd. at 11,920 ¶ 139.

the mission-critical services supported by the Lino Lakes facility and cause Inmarsat to incur massive costs as the sands shift beneath it. More importantly, the *mere possibility* of this outcome inhibits Inmarsat's ability to continue committing resources to the operation, expansion, and enhancement of the existing facility—and to construct new earth and space stations in the 28 GHz band that support more users, more bandwidth, and more advanced services.

Adding further to the risk to Inmarsat's operations is the potential for significant interference to the in-orbit satellite receivers operating in the 28 GHz band. The spot beams used on Ka-band satellites receive the desired signal from the earth stations within the beam, but also receive interference from any terrestrial stations in the beam operating on the same frequencies. Interference to the satellite receiver is particularly disruptive since, depending on the power level, it would prevent or harm the service to all earth stations within the footprint which communicate with that satellite. If excessive interference were to occur to a satellite feeder uplink from FUS systems, the only conceivable option to mitigate the interference would be to re-point the satellite spot beam to another area where terrestrial interference would not occur, and re-locate the feeder link earth station to another location with the new spot beam footprint. This would not be possible in all cases, considering inter-satellite coordination constraints and possible design constraints on the satellite. Even where technically possible, this mitigation would be enormously costly and time consuming. Where the satellite spot beams are used for service links, *i.e.*, for communicating directly to the satellite user terminals, moving the spot beam to another location would remove the ability to serve satellite customers in and near to the areas of FUS deployment and hence is clearly not a feasible mitigation strategy.

The "footprint" of the I-5 satellite spot beam covers an area of several hundred thousands of square kilometers and the aggregate interference from the FUS base stations and

terminals within this area would be received by the satellite. Considering the high density envisaged for 5G base stations - a typical cell radius of around 200 meters - many thousands of simultaneous interferers could be expected in the satellite footprint. A critical parameter to control interference is the *maximum EIRP spectral density* from FUS base stations and terminals. The Commission has suggested EIRP spectral density limits higher than those suggested by terrestrial 5G proponents such as NYU and Samsung, and higher limits still for FUS systems in rural areas.[18] But there is no technical analysis presented to demonstrate that FSS operations would not be harmed by interference from FUS systems. The Commission must carefully consider the potential for interference to satellite uplinks and ensure that adequate limits are applied to FUS systems.

Finally, the Commission also expressed its intent to "initiate further proceedings to address satellite operations on movable platforms . . . in multiple bands," including the 28 GHz band, based on "evolving technology and market conditions."[19] Inmarsat supports this intention – and suggests only that these further proceedings be initiated promptly – because the technology supporting deployment of aeronautical and maritime terminals has already arrived, and the market is more than ready for these services. Even as passengers and crew wait for higher speed connectivity and more consistent quality of service, the number of flights and ship routes with WiFi access has been steadily increasing. And with new Ka-band services like Global Xpress, the amount of traffic consumed from the skies and on the ocean is set to take off. The availability of maritime and aviation terminals will bring more bandwidth to more long-haul

[18] *Id.* at 11,878 ¶ 275.

[19] *Id.* at 11,925-26 ¶ 159.

routes and deliver consumers consistent, continuous, and high-speed – which is exactly what they demand and deserve.

B. The 39 GHz and 37 GHz Bands

In the 39 GHz band, the Commission's plan mirrors its proposal for the 28 GHz band. Incumbent 39 GHz licensees would receive an FUS license by rule, with remaining licenses to be assigned by auction. Although FSS earth stations have a co-primary allocation in the 39 GHz band, the Commission proposes to allow future earth stations to operate on a co-primary basis in this spectrum only if they are located outside the territory of an incumbent 39 GHz licensee and obtain a waiver.[20] In the 37 GHz band, the Commission proposes a hybrid licensing regime that would allow "local area" networks to operate by rule, and wide area, carrier-model networks to obtain licenses at auction.[21] The Commission did not sufficiently consider whether and how it should facilitate satellite use of this band.

Both the 39 GHz and 37 GHz bands remain critically important to Inmarsat and other satellite providers. Like other satellite operators, Inmarsat is experiencing rapid growth in data consumption over its networks. As newer generation constellations support even faster speeds than the satellites that preceded them, the bandwidth used by the typical satellite consumer will only increase, and at the current pace, existing downlink spectrum will soon become overcrowded. This means that satellite operators must accelerate their efforts to develop V-band spectrum for satellite expansion.

Anticipating that it would need to develop higher frequency spectrum for satellite use, Inmarsat has already committed substantial resources to the use of the 37 GHz and 39 GHz

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[20] *Id.* at 11,926 ¶ 162.

[21] *Id.* at 11,909-10 ¶ 100.

bands for satellite operations. In July 2013, in partnership with the European Space Association ("ESA"), Inmarsat launched Alphasat, one of the most technically advanced telecommunications satellites ever constructed for civilian applications. In addition to supporting enhanced communications services in Europe, the Middle East, and Africa, Alphasat includes a dedicated payload to explore commercial use of the Q/V-bands for satellite transmissions. Inmarsat expects to apply for earth station authorization in the V-band in the near future.

The Commission's proposed rules for the 39 GHz and 37 GHz bands, however, would undermine these efforts, discourage satellite operators from continuing to invest in V-band spectrum, and leave satellite operators searching for spectrum assets suitable to support the expansion of their services. Inmarsat cannot commit the substantial financial resources required to plan, construct, and launch satellite space stations and ground infrastructure on the basis of the limited, and inherently uncertain, waiver process proposed for the 39 GHz band. Nor can Inmarsat rely on the hope that it will be able to secure rights from a terrestrial carrier. And Inmarsat certainly cannot expect to find reliable access to spectrum in a complex and untested hybrid licensing regime. If the Commission does not provide satellite operators a sustainable path for expansion spectrum, it risks depressing satellite investments at the very time they are critically needed.

C. The Commission Should Provide FSS Operators with the Certainty They Need to Continue, Expand, and Enhance Their Services.

Inmarsat emphasizes its support for the global deployment of 5G services provided both terrestrially and by satellite, and, indeed, expects to play a critical role in their delivery. Moreover, there is simply no evidence on the record which suggests that FSS earth stations operating on a protected basis would derail efforts to deploy terrestrial 5G networks. Thus, to provide FSS operators with the certainty they need to continue, expand, and enhance their

services, the Commission should automatically upgrade FSS earth stations to co-primary status in the 28 GHz band, and retain the co-primary allocation for FSS earth stations in the 39 GHz and 37 GHz bands.

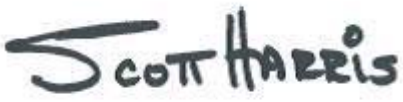
The Commission should, at the very least, grant co-primary status to all gateway earth stations authorized to operate at the time of the Commission's first flexible use auction in the 28 GHz band, provided that the earth station can demonstrate that it will not cause harmful interference to existing terrestrial services. While this accommodation is hardly enough to ensure that the United States maintains its position as a leader in advanced satellite services—or that 5G services can deliver their full potential—it would allow companies like Inmarsat to continue operating earth stations in which they have sunk enormous resources, without prejudicing incumbent licensees. Indeed, incumbent LMDS licensees would still benefit substantially from this proposal, as they would gain flexible use rights over much of the BTA for which they are licensed.

CONCLUSION

Inmarsat strongly supports the expansion of broadband terrestrial services and the development 5G technologies. It merely encourages the Commission to adopt a broader vision of 5G in this proceeding. Satellite services are a critical component of 5G services. Pioneering spectrum regulation must therefore allow both satellite and terrestrial services to flourish.

This is one area where the Commission, and more importantly consumers, can have it all. A sufficiently nuanced, balanced, and common sense proposal will ensure that satellite networks can enhance the capabilities of terrestrial networks, rather than be destroyed by them.

Respectfully submitted,



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