**6712-01**

**FEDERAL COMMUICATIONS COMMISSION**

**47 CFR Parts 0 and 101**

**[WT Docket No. 20-133; FCC 24-16; FR ID 207939]**

**Modernizing and Expanding Access to the 70/80/90 GHz Bands; Report and Order**

**AGENCY:** Federal Communications Commission.

**ACTION:** Final rule.

**SUMMARY:** In this document, the Federal Communications Commission (Commission) continues to play a leading role in fostering innovation in the provisioning of broadband, including through novel technological solutions as well as fifth-generation wireless technology (5G). Meeting the non-stop growth in demand for wireless broadband connectivity is more important than ever due to the outsized impact the Internet has on its work, education, health care, and personal connections. Recognizing this reality, and to help close the digital divide, the *Report and Order* adopts new rules and updates preexisting ones. The Commission also updates its rules to permit the use of smaller and lower-cost antennas to facilitate the provision of backhaul service and mandates a channelization plan . Finally, the Commission adopts changes to the link registration process in certain bands requiring certification of construction of registered links to promote more efficient use of this spectrum and improve the accuracy of the link registration database.

**DATES:** Effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, except for the addition of § 101.147(z)(3) at instruction 9, which is effective on September 1, 2024. The amendments to §§ 101.63(b) at instruction 5, 101.1523(a) and (e) at instruction 12, and 101.1528(a)(11), (b)(10), and (d) at instruction 14 are delayed indefinitely. The Federal Communications Commission will publish a document in the *Federal Register* announcing the effective date for the amendments to §§ 101.63(b), 101.1523(a) and (e), and 101.1528(a)(11), (b)(10), and (d).

**FOR FURTHER INFORMATION CONTACT:** Jeffrey Tignor, Wireless Telecommunications Bureau, Broadband Division, at Jeffrey.Tignor@fcc.gov or 202-418-0774.

**SUPPLEMENTARY INFORMATION:** This is a summary of the Commission's *Report and Order* in WT Docket No. 20-33, FCC 24-16; adopted on January 24, 2024 and released on January 26, 2024. The full text of this document (as corrected by Erratum released on April 10, 2024) is available at https://docs.fcc.gov/public/attachments/FCC-24-16A1.pdf.

**Final Regulatory Flexibility Analysis**

As required by the Regulatory Flexibility Act of 1980, as amended (RFA), an Initial Regulatory Flexibility Analysis (IRFA) was incorporated into the *Modernizing and Expanding Access to the 70/80/90 GHz Bands, Notice of Proposed Rulemaking (70/80/90 GHz NPRM)* released in June 2020 (85 FR 40168, July 6, 2020). The Commission sought written public comment on the proposals in the *NPRM*, including comments on the IRFA. No comments were filed addressing the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.

**Congressional Review Act**

The Commission will submit the *Report and Order* to the Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget, for concurrence as to whether this rule is "major" or "non-major" under the Congressional Review Act, 5 U.S.C. 804(2). The Commission will send a copy of this *Report and Order* to Congress and the Government Accountability Office pursuant to 5 U.S.C. 801(a)(1)(A).

## I. BACKGROUND

1. In the United States, the 71–76 GHz, 81–86 GHz, 92–94 GHz, and 94.1–95 GHz bands (collectively, the 70/80/90 GHz bands) are allocated on a co-primary basis for Federal and non-Federal use, as follows.

| Band | Non-Federal Use | Federal Use |
|---|---|---|
| 71–74 GHz | Fixed, Fixed Satellite, Mobile, and Mobile Satellite | Fixed, Fixed Satellite, Mobile, and Mobile Satellite |
| 74–76 GHz[1] | Fixed, Fixed Satellite, Mobile, Broadcasting, and Broadcasting Satellite | Fixed, Fixed Satellite, and Mobile |
| 81–84 GHz | Fixed, Fixed Satellite, Mobile, Mobile Satellite, and Radio Astronomy | Fixed, Fixed Satellite, Mobile, Mobile Satellite, and Radio Astronomy |
| 84–86 GHz | Fixed, Fixed Satellite, Mobile, and Radio Astronomy | Fixed, Fixed Satellite, Mobile, and Radio Astronomy |
| 92–94 GHz, 94.1–95 GHz | Fixed, Mobile, Radio Astronomy, and Radiolocation | Fixed, Mobile, Radio Astronomy, and Radiolocation |

In the 71–76 GHz (70 GHz) and 81–86 GHz (80 GHz) bands Fixed, Mobile, and Broadcasting services must not cause harmful interference to, nor claim protection from, Federal Fixed-Satellite Service operations located at 28 military installations. In addition, in the 80 GHz band, and in the 92–94 GHz and 94.1–95 GHz bands (collectively, the 90 GHz band), licensees proposing to register links located near 18 radio astronomy observatories must coordinate their proposed links with those observatories. The 94–94.1 GHz frequencies are allocated for Federal use for Earth Exploration Satellite (active), Radiolocation, and Space Research (active) and for non-Federal use for Radiolocation. Additionally, the adjacent 86–92 GHz band is allocated for Federal and non-Federal Earth Exploration-Satellite (passive), Space Research (passive), and Radio Astronomy services and is subject to footnote US246.

2. In 2003, the Commission established service rules for non-Federal use of the 70/80/90 GHz bands through a two-step, non-exclusive licensing regime. Users first obtain a nationwide, non-exclusive license for the entire 12.9 gigahertz of the 70/80/90 GHz bands and then register individual links in a database administered by third-party database managers. Since 2004, the Wireless Telecommunications Bureau (WTB) has designated four entities to be database managers; there are currently two: Comsearch and Micronet Communications, Inc. In order for a link to be registered, it must be coordinated successfully with Federal operations—typically through the National Telecommunications and Information Administration's (NTIA) online, automated mechanism. If a proposed link does not interfere with existing Federal operations then it is given a "green light;" if it may

[1] Additional allocations for Federal and non-Federal use for Space Research are on a secondary basis.

interfere with existing Federal operations, then it is given a "yellow light," indicating that the licensee must file a registration application for the link with the FCC for coordination with NTIA. The "green light" / "yellow light" system protects the sensitive nature of the locations of military installations. Also, the licensee must provide an analysis to the third-party database manager demonstrating that the proposed link will neither cause harmful interference to, nor receive harmful interference from, any previously registered non-government link. Licensees are afforded first-in-time priority for successfully registered links relative to links that are successfully registered at a later point in time. Registered links must be constructed within 12 months of their registration. Under part 101, non-Federal licensees may use the 70/80/90 GHz bands for any point-to-point, non-broadcast service.

3. In June 2020, the Commission adopted the aforementioned *70/80/90 GHz NPRM* in this proceeding, seeking comment on both adopting new rules and updating preexisting rules to further enable non-Federal uses of the 70/80/90 GHz bands. Among a range of issues and proposals—which the Commission said it would work with NTIA to evaluate—the *70/80/90 GHz NPRM* sought comment on requests from Aeronet Global Communications, Inc. (Aeronet) to authorize point-to-point links to endpoints in motion in the 70 GHz and 80 GHz bands to facilitate broadband service to ships and aircraft in motion, as well as on whether to classify those links as "mobile" service (the Aeronet Petitions). Although the Aeronet Petitions proposed that endpoints in motion operations be permitted in the 70, 80 and 90 GHz bands, several parties that commented on the Aeronet Petitions expressed concerns about co-existence with other services in the 90 GHz band. The *70/80/90 GHz NPRM* did not propose to authorize endpoints in motion in the 90 GHz band. Noting that the 70/80/90 GHz bands could provide a "unique spectrum resource" for "the provisioning of broadband services to airplanes, ships, and other antennas in motion," the Commission sought comment on technical and operational rules to allow these new service offerings in the 70 GHz and 80 GHz bands and to mitigate interference to incumbents and other proposed users of these bands and adjacent bands.

4. The *70/80/90 GHz NPRM* also proposed several changes to the antenna standards for the 70 GHz and 80 GHz bands to provide greater flexibility in deploying wireless backhaul, noting industry's assessment of its needs. The *70/80/90 GHz NPRM* sought comment as well on whether adopting a channelization plan would promote more efficient use of the 70 GHz and 80 GHz bands. In addition, the

*70/80/90 GHz NPRM* asked about whether the Commission should make changes to the link registration rules for the 70, 80, and 90 GHz bands. Parties including aeronautical and satellite companies, radio astronomy interests, equipment manufacturers, fixed and mobile wireless entities, and organizations focused on meteorology filed in response to the *70/80/90 GHz NPRM*. Commenters discussed Aeronet's proposals, the suitability of the bands for backhaul, and a range of ways to improve the bands' overall functionality (such as channelization and updates to the relevant antenna standards and link registration process).

5. Following the *70/80/90 GHz NPRM*, in October 2021 WTB issued a Public Notice seeking to further develop the record on the use of High Altitude Platform Stations (*HAPS Public Notice*) or other stratospheric-based platform services in the 70/80/90 GHz bands. The Commission's rules define a "High Altitude Platform Station" as a "station located on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the earth." Fifteen Comments and five Reply Comments were filed in response to the *HAPS Public Notice*, with participants ranging from past commenters on the original *70/80/90 GHz NPRM* to additional governmental entities and public interest groups, among others.

6. In the *70/80/90 GHz NPRM*, the Commission committed to coordinate with NTIA prior to adopting any rules in this proceeding that would affect Federal users, given that allocations for the 70 GHz and 80 GHz bands include both Federal and non-Federal use. In response to the *70/80/90 GHz NPRM*, NTIA established a technical interchange group (TIG) with representatives from the affected Federal agencies, including National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the National Science Foundation, the Department of the Air Force, and NTIA itself (collectively, the Federal Agencies) (Federal Agencies Letter). Commission staff participated in regular information exchange meetings with the TIG. The Federal Agencies, through NTIA, submitted a summary of their analyses and a set of proposed interference mitigation measures to the record. On October 18, 2023, the Bureau issued a Public Notice seeking to refresh the overall record in this proceeding and seeking comment, in particular, on the Federal Agencies' proposals (*Refresh Public Notice*). Nine parties—eight of which had already participated in the record to date—filed comments in response to the *Refresh Public Notice*.

## II. REPORT AND ORDER

7. After reviewing the record, the Commission adopts rules to allow for point-to-point links to endpoints in motion—specifically, links on aircraft and on ships—in the 70 GHz and 80 GHz bands under its part 101 rules. The Commission also adopts changes to its rules to facilitate the use of the 70 and 80 GHz bands for backhaul, including through the use of smaller antennas, and to improve the accuracy of the link registration database for the 70/80/90 GHz bands. Specifically, the Commission adopts proposals to increase maximum antenna beamwidth from 1.2 degrees to 2.2 degrees; reduce minimum antenna gain from 43 dBi to 38 dBi while retaining the proportional EIRP reduction requirement; eliminate the co-polar and relax the cross-polar discrimination requirements at angles less than 5 degrees; revise the co-polar and cross-polar discrimination requirements at angles between 5 degrees and 180 degrees; and allow minor modifications to registrations in the 70/80/90 GHz bands without the loss of first-in-time rights. The Commission further adopts a channelization plan consistent with Recommendation ITU-R F.2006. Finally, the Commission adopts a requirement that licensees certify that each link is constructed and operating within 12 months of successful registration in the link registration system (LRS) administered by third-party database managers.

### A. Enabling Point-to-Point Communications to Aircraft and Ships

8. Pursuant to the Aeronet Petitions—one addressing aeronautical service, the other maritime service—the *70/80/90 GHz NPRM* proposed to authorize point-to-point links to endpoints in motion on aircraft and on ships in the 70 GHz and 80 GHz bands. The *70/80/90 GHz NPRM* sought comment on this proposal, with a focus on potential impacts on other services, including radio astronomy service (RAS), Earth Exploration-Satellite Service (passive) (EESS), FSS, and terrestrial fixed point-to-point links in the Fixed Service (FS).

9. As noted above, in the *70/80/90 GHz NPRM* the Commission committed to coordinate with NTIA prior to adopting any rules in this proceeding that would affect Federal users; this coordination ultimately resulted in the work of NTIA's TIG and the submission of the Federal Agencies Letter, which was one of the topics specifically noted in the Commission's *Refresh Public Notice*. Both the Federal Agencies Letter and the responsive filings in the record have advanced the Commission's efforts to enable innovative new uses of this band in both the aeronautical and the maritime contexts, while

ensuring adequate interference protection for incumbents and other authorized services in these and adjacent bands.

10. In order to facilitate increased provision of broadband service and enhanced competition in the aviation and maritime markets, the Commission adopts rules authorizing point-to-point links to endpoints in motion on aircraft and on ships, pursuant to specifications and restrictions described below. These rules will permit increased broadband access in this space while protecting important incumbent and Federal operations.

### 1. Authorization and Framework

11. *Classification of Services.* The Aeronet Petitions requested that the Commission categorize Aeronet's proposed services as fixed services. In the *70/80/90 GHz NPRM*, however, the Commission instead proposed to classify service to endpoints in motion as a mobile service, because its rules define "fixed service" as a "radiocommunication service between specified fixed points," which endpoints in motion inherently are not. Several commenters supported the Commission's approach, including Boeing, the Fixed Wireless Communications Coalition (FWCC), and Loon, which also requested that the Commission makes sure any definition of "mobile" include mobile components of HAPS systems as well. The Wireless Internet Service Providers Association (WISPA) alone opposed mobile classification, on the grounds that one endpoint of the transmission is fixed, and therefore the service does not reach "full mobility," and also because the appropriate comparison is with the Fixed Satellite Service, which may provide service to Earth Stations in Motion (ESIMs) without being reclassified as "Mobile-Satellite Services." WISPA also argued that if the Commission does classify services to endpoints in motion as mobile, the Commission should classify them as aeronautical mobile and maritime mobile specifically, as those terms are defined in the Commission's existing rules.

12. The Commission finds WISPA's arguments unpersuasive. Other mobile services, for example cellular service, ubiquitously involve transmissions from one fixed point (the base station) to a variety of mobile points (the cell phone), without risking reclassification as a fixed service. As between "mobile" and "aeronautical mobile," the Commission notes that a classification as simply "mobile" encompasses aeronautical use. Similarly, as between "mobile" and "maritime mobile," a classification as simply "mobile" encompasses maritime use. Given the otherwise favorable record, and the

Commission's existing rules, the Commission concludes that the service the Commission authorize, involving transmissions to and from aeronautical endpoints in motion, is a mobile service.

13. As noted in the *70/80/90 GHz NPRM*, the Commission's authorization of a mobile service in the 70 GHz and 80 GHz bands constitutes a revisiting of the Commission's previous actions in the Spectrum Frontiers proceeding. At that time, the Commission declined to authorize mobile use in the 70 GHz and 80 GHz bands, but reserved the right to revisit the issue of possible methods of promoting coexistence between fixed links and mobile operations as mobile deployments increased in other millimeter-wave bands, as technology developed, and as additional options or frameworks for coexistence of fixed and mobile services in the same band were brought forth. In the six years since the *2017 Spectrum Frontiers Order*, there have been considerable advances in both technology and sharing paradigms—and Aeronet and other parties have continued to submit new analyses on possible coexistence. The Commission therefore conclude that revisiting the Commission's previous stance on this matter is warranted and appropriate. The Commission notes that the mobile services that the Commission permits pursuant to its decisions in this *Report and Order* are subject to significantly different rules and requirements than the part 30 rules the Commission contemplated in 2017.

14. *Limitation to 70 GHz and 80 GHz Bands*. In the *70/80/90 GHz NPRM*, the Commission noted various concerns already in the record regarding potential harmful interference to Enhanced Flight Vision Systems (EFVS) and Foreign Object Detection (FOD) systems from Aeronet's proposed service in the 90 GHz band and, on that basis, proposed to allow endpoint-in-motion operations only in the 70 GHz and 80 GHz bands, while continuing to seek comment on the issue. Since then, additional concerns have been raised by numerous other entities regarding proposed aeronautical use of the 90 GHz band, due to both potential incompatibility with proposed use by EFVS and FOD systems, and potential harmful interference to radio astronomy and remote sensing receivers in the 86–92 GHz band and at 94.0–94.1 GHz. Given the many concerns raised in the record, and the relatively greater interest expressed in expanding use of the 70 GHz and 80 GHz bands, the Commission concludes that the risk of harmful interference to incumbent and adjacent services outweighs the benefit to consumers of allowing service to aeronautical endpoints-in-motion in the 90 GHz band. As proposed in the *70/80/90 GHz NPRM*, the Commission therefore authorizes endpoint-in-motion service only in the 70 and 80 GHz bands. At this

juncture, the new service covers: (1) in the aeronautical space, ground-to-air and air-to-ground transmissions between ground stations and aircraft, and air-to-air transmission between aircraft in flight; and (2) in the maritime space, ship-to-shore, shore-to-ship, shore-to-aerostat, aerostat-to-ship, aerostat-to-shore, and ship-to-ship transmissions. For purposes of both the *Report and Order* and *Further Notice*, the Commission considers the term "aerostat" to mean an airborne transmitter operating within a small specified area, below 1,000 feet of elevation, regardless of method of propulsion.

15. *Coordination, Licensing, and Registration*. In the *70/80/90 GHz NPRM*, the Commission sought comment generally on what changes to the 70/80/90 GHz coordination, licensing, and registration framework might be necessary in order to facilitate the operation of endpoints in motion under part 101. The Commission also proposed to incorporate such operations, to the extent ultimately authorized, into the current framework of non-exclusive, nationwide licensing used for fixed point-to-point operations in these bands. The record is fairly thin on the specifics of the appropriate licensing framework; most commenters focused on whether the Commission should authorize this service as an initial matter. However, several commenters did voice support for including any new service in the existing third-party database management system.

16. In order to allow service to aeronautical and maritime endpoints in motion to deploy efficiently and without causing harmful interference to incumbent operations and other services in these bands, the applicable licensing mechanism must support adequate coordination with those other services without being unduly burdensome on both incumbent and new operators. To this end, the Commission will require prospective operators of service to aeronautical and maritime endpoints in motion to first apply for and receive a nationwide, non-exclusive license. This license will establish the prospective operator's qualification to be a licensee and will serve as a blanket license for: (1) on the aeronautical side, air-to-air operations, and as a prerequisite to register ground-to-air (GTA) stations and associated air-to-ground (ATG) transmission; and (2) on the maritime side, as a prerequisite to register ship-to-shore, shore-to-ship, shore-to-aerostat, aerostat-to-ship, and aerostat-to-shore transmissions. The Commission clarifies that as of the effective date of the rules, the Commission is adopting, all nationwide, non-exclusive licenses for the 70/80/90 GHz service will include the service areas set forth in section 101.1501, as revised.

17. In the matter of coordinating and registering individual aeronautical stations and links, the Commission proposed in the *70/80/90 GHz NPRM* to require coordination and registration for not only GTA stations and ATG transmissions, but also air-to-air links between two aircraft in motion. The Commission also sought comment on how all types of links should be represented or described in their registrations, as the current system, designed for fixed point-to-point links on the ground, does not account for potential differences in altitude or the varying orientation of links to endpoints in motion. Several commenters noted the potential difficulty of coordinating air-to-air links, due not only to these different characteristics, but also their temporary and transient nature. Aeronet proposed coordinating three-dimensional polyhedrons for air-to-air links, which DSA supports, within a horizontal altitude band from 10,000 to 50,000 feet. However, concerns in the record about potential harmful interference from air-to-air transmissions stem mainly from such transmissions' specific angle, direction, or distance from specific sites (most of which would not be addressed by registration of polyhedrons) that can be addressed directly with specific limitations. Due to the difficulties of adequately representing the potential interference from these links in the existing database structure, and in light of the various interference mitigation measures the Commission also adopts (discussed below) to answer those concerns, the Commission will not require registration or coordination of individual air-to-air links.

18. In the matter of coordinating and registering individual maritime stations and links, the Commission proposed in the *70/80/90 GHz NPRM* to require coordination and registration for not only ship-to-shore and shore-to-ship transmissions, but also ship-to-ship and ship-to-node (i.e., as described in this item ship-to-aerostat). The Commission also sought comment on how all types of links should be represented or described in their registrations, as the current system—designed for two-dimensional fixed point-to-point links on the ground—does not account for potential differences in three-dimensional space-to-endpoints in motion. As explained immediately above, commenters focused on the potential difficulty of coordinating air-to-air links, and Aeronet proposed a system of three-dimensional polyhedrons for the same. Similar in-depth discussion around maritime-related links did not develop in the record.

19. After receiving the nationwide license, aeronautical operators will coordinate with Federal operators and register GTA stations and associated ATG transmissions and must not operate such facilities until registration has successfully been completed. Air-to-air operations will not be separately

registered but may only operate under a nationwide license if the communication is associated with a registered GTA or ATG registration. All GTA and ATG operations, including operations transmitting to or from aeronautical endpoints in motion and associated ground stations, will be afforded protection from other operations on a first-in-time basis, and must afford those other operations the relevant first-in-time protections in turn.[2]

20. After receiving the nationwide license, maritime operators will coordinate with Federal operators and register shore-to-ship transmitters, shore-to-aerostat transmitters, ship-to-shore transmitters, and aerostat relay stations. As with GTA and ATG transmissions, all such maritime operators must not operate any facilities until registration has successfully been completed. All such maritime operations will be afforded protection from other operations on a first-in-time basis and must afford those other operations the relevant first-in-time protections in turn.

21. The Commission delegates authority to WTB to establish specific procedures to be followed for coordinating and registering aeronautical and maritime stations and their associated transmissions, to be set forth in a future publication or publications. The Commission note, in relation to technical discussion raised by certain parties in the docket, that validation of new aeronautical and maritime systems' ability to not cause interference may involve processes beyond the third-party database system. Additionally, the Commission delegates authority to WTB and the Office of Engineering and Technology (OET) to establish a process, in coordination with NTIA, for demonstrating that technologies for point-to-endpoint-in-motion communications to aircraft and ships are capable of meeting the specific technical and operating requirements adopted in this *Report and Order*. The Commission instructs WTB and OET to take such actions as authorized by sections 0.241(l) and 0.331(g) of its rules, which the Commission adopts, and to do so expeditiously.

### 2. Technical and Operational Rules

22. In the *70/80/90 GHz NPRM,* the Commission sought comment on what changes to its

[2] The Commission notes the request of CTIA and others that the Commission grants priority to fixed service in these bands over new uses. Fixed service in these bands has been co-primary with other services, including mobile service, for some time. Adopting new service rules for these existing allocations does not change the co-primary status of the fixed service. Additionally, incorporating these new aeronautical and maritime services into the existing registration regime with first-in-time protection effectively protects all existing operations, including fixed operations, from all deployments in these services. That subsequent deployments will be protected from each other on a first in time basis is also consistent with the co-primary nature of the allocations.

current rules might be necessary to facilitate the contemplated aeronautical and maritime services, while protecting incumbent and Federal operations. The Commission also sought comment generally on any interference mitigation measures not specifically mentioned that might be necessary to protect other operations.

23. In response to the *70/80/90 GHz NPRM*, some commenters argued—focusing on the aeronautical context in particular—that a more developed record would be necessary to support the authorization of aeronautical mobile service along the lines proposed by Aeronet, given the potential for interference to incumbent and other potential services. Other commenters disagreed. Maritime service was largely unaddressed in the record. A small number of parties—including SpaceX, T-Mobile, and Verizon—raised more specific, albeit still highly generalized, objections to the *70/80/90 GHz NPRM*'s proposed maritime authorizations, citing in part concerns over potential impacts on fixed wireless backhaul, among other issues. Others generally endorsed the adoption of the proposed maritime regime.

24. Since the initial comment period to the *70/80/90 GHz NPRM*, additional submissions to the record, including detailed contributions from NTIA and other Federal agencies, have enhanced the depth of the record. The Commission's increased understanding of potential interactions between Aeronet's proposed service and incumbent, adjacent, and other potential operations (including sensitive operations such as weather satellites in the EESS) now allows us to set forth a series of technical and operational rules calculated to protect all services from harmful interference within the 70 GHz and 80 GHz bands and adjacent to them.

25. Except as noted below, the aeronautical and maritime mobile services the Commission authorize will be governed by part 101 of its rules. Though part 101 currently encompasses only fixed services, the Commission finds it appropriate to place the service rules governing aeronautical and maritime mobile services in the 70 GHz and 80 GHz bands within the same rule part. In addition, operators of these new services must coordinate with operators in the existing FS, and part 101 is the logical home for rules related to that coordination. The technical and operational rules the Commission sets forth below are sufficient to accommodate the different technical characteristics of these aeronautical and maritime transmissions.

26. *Guard Bands.* The Commission did not specifically seek comment in the *70/80/90 GHz*

*NPRM* on the potential use of guard bands as means of protecting services in adjacent bands from harmful interference. Several commenters suggest them, particularly to protect both EESS satellites and RAS facilities in the 86–92 GHz band. However, the analysis submitted by the Federal Agencies, which includes NASA and NOAA, instead relies upon specified out of band emissions (OOBE) limits to protect EESS. Because the Federal Agencies' analysis supports coexistence between the new aeronautical and maritime services and services in adjacent bands without the use of a guard band, no commenters objected to the lack of guard bands in response to the *Refresh Public Notice*, and based on the Commission's engineering analysis of the Federal Agencies' recommendations, the Commission declines to adopt guard bands as an interference protection measure here.

27. *Transmission Power Levels.* In the *70/80/90 GHz NPRM*, the Commission sought comment on Aeronet's request to increase the maximum allowable mobile equivalent isotropically radiated power (EIRP) for the 70 GHz and 80 GHz bands from +55 dBW to +57 dBW. CORF and satellite operators objected to this proposal, on the grounds that an increased power level would unacceptably increase the risk of harmful interference to FSS and RAS operations. Qualcomm supported the increase, arguing that atmospheric attenuation in these bands should be sufficient to mitigate interference concerns. Aeronet argues that the proposed increase is minimal and that the highly directional nature of transmissions in its proposed service will work to avoid incidents of harmful interference. The Federal Agencies' analysis of potential interference into Federal operations assumes +57 dBW, and suggests that the recommended interference mitigation measures in its report would be sufficient to protect Federal operations from an aeronautical mobile service operating at that power level.

28. The Commission acknowledges the concerns of satellite operators and the RAS community about potential interference from the services that this item contemplates, as discussed in more detail below. However, the Federal Agencies' analysis addresses potential harmful interference to both RAS and FSS operations, and the Commission find it persuasive based on its review of the record and its independent analysis. As the Commission also adopts the interference mitigation measures recommended in that report, the Commission adopts a maximum EIRP level of +57 dBW for transmissions in these new aeronautical and maritime mobile services.

**a. Transmissions Between Aircraft and Ground Stations**

29. In introducing a new aeronautical mobile service to these bands, care must be taken to ensure compatibility with existing and other authorized services, both in the 70 GHz and 80 GHz bands, and adjacent to them. The record reflects a variety of concerns about the potential impact on these other services. To address these concerns, the Commission adopts a number of interference mitigation measures specifically related to transmissions between ground stations and aircraft in flight, described below. Ground-to-air and air-to-ground transmissions are limited to the 80 GHz and 70 GHz bands, respectively; ground stations must be located a minimum distance away from RAS facilities, fixed stations, and FSS earth stations; specific OOBE limits above 86 GHz must be observed; and minimum and maximum elevation angles for ground-to-air transmissions are required.

30. Several commenters expressed concern regarding air-to-ground transmissions in the 80 GHz band, due to the potential for such transmissions to cause harmful interference to RAS operations. No party, including Aeronet, has argued that downlink transmissions in the 80 GHz band are necessary to provide aeronautical service, provided that the 70 GHz band is available for that purpose. AT&T notes in its comments that a channel plan that designates different parts of the 70 GHz or 80 GHz bands for uplink versus downlink signals would be beneficial to reduce self-interference to air-to-ground and ground-to-air mobile systems. In addition, having air-to-ground transmissions in the 70 GHz band and ground-to-air transmissions in the 80 GHz band creates directional consistency with the bands designated for space-to-Earth (71–76 GHz) and Earth-to-space (81–86 GHz) in the FSS service. Aeronet's technical study indicates compatibility with the FSS services while assuming air-to-ground transmissions in the 70 GHz band and ground-to-air transmissions in the 80 GHz band. SpaceX supported Aeronet's study. The Commission therefore authorizes air-to-ground transmissions only in the 70 GHz band.

31. Many commenters suggested that some separation distance between aeronautical ground stations and operations of other services, including RAS stations, FSS earth stations, and fixed point-to-point links, would be either advisable or necessary to reduce the risk of harmful interference. The Federal Agencies' analysis provides specific values for such separation distances: greater than 10 km for licensed FSS earth stations, 10 km for fixed point-to-point transmitters, and 150 km for RAS operations. That analysis also asserts that in order to protect RAS operations, ground stations should not transmit in the direction of an RAS facility, or receive transmissions from aircraft in that direction, such that the

transmission enters the appropriate "zone of avoidance" around the facility. In response to the *Refresh Public Notice*, NRAO raised concerns that this 150 km separation distance may be inadequate to protect RAS operations in the 76–81 GHz band specifically.

32. The Commission finds the conclusions of the Federal Agencies' analysis persuasive. No other party has submitted alternative suggestions for separation distances with respect to Federal operations. With regard to NRAO's concerns, the Commission notes that as the Technical Interchange Group that produced the Federal Agencies Letter specifically considered interference into the 76–81 GHz band, and as NSF, with which NRAO is affiliated, participated in the TIG and endorsed its output, the Commission will defer to the expertise of NSF in this matter. Accordingly, the Commission adopts a minimum separation distance of 150 km between RAS facilities and aeronautical ground stations.

33. With respect to FS and FSS, although the 10 km distances were calculated specifically with Federal operations in mind, the Commission finds that a 10 km distance separation should apply with respect to non-Federal operations in these services. With respect to FSS, the record generally supports the 10 km separation distance without objection. For example, Aeronet's study showing compatibility between its system and FSS concluded that a 10 km separation distance would be sufficient to prevent interference, and SpaceX supports this conclusion. With respect to FS, Aeronet contends that applying a 10 km separation requirement for ground stations is unnecessary and possibly counterproductive given that Aeronet expects to, in some cases, be able to co-locate with backhaul links. FWCC and CTIA, on the other hand, assert that the 10 km separation distance is necessary to protect non-Federal FS stations. Based on the Commission's assessment of the record, the Commission does not find any technical reason to adopt a different separation distance between ground stations and non-Federal FS stations than the Commission adopts for the separation between ground stations and Federal FS stations. Moreover, in response to Aeronet's concern that a 10 km separation distance could preclude co-location of ground stations with backhaul links, the Commission notes that ground stations can be separated less than 10 km from backhaul links pursuant to coordination agreements, and the Commission encourages all parties to explore more efficient interference protection parameters in the context of those discussions. The Commission finds that a 10 km coordination requirement strikes the appropriate balance for sharing between the longstanding use of the bands under the fixed allocation and the new uses under the co-

primary mobile allocation—including ground stations with antennas that are not static.

34. While Comsearch assumed a larger coordination area around FS stations than 10 km, the Commission notes that its analysis uses conservative assumptions to calculate an area on the ground that could be illuminated by an aircraft antenna (for example, the Comsearch analysis assumes an aircraft altitude of 50,000 ft, whereas most commercial aircraft typically fly between 31,000 and 38,000 feet). This worst-case calculation does not take into account a number of factors that would reduce the interference potential, most notably the directional nature of transmissions from the aircraft. Considering the relative potential interference between ground stations and FSS versus FS, the Commission notes the following: (1) the elevation angle of FSS earth station receive antennas makes them more likely to be co-linear with the air-to-ground link; (2) due to the long path from space-to-Earth, the desired signal at a satellite earth station from a satellite would typically be weaker than the desired signal at an FS receiver from its transmitter (in other words, the C in the C/I ratio would be higher for any FS station); and (3) the Federal FSS study assumed an interference threshold of I/N = -12.2 dB would be required to protect FSS, whereas the typical interference threshold for FS is 1.0 dB of degradation of the static threshold of the protected receiver, which equates to an I/N of -6 dB. These factors all indicate that FS would be less susceptible to interference from air-to-ground or ground-to-air links than FSS. The Commission therefore concludes that there is no need for the separation distance between ground stations and FS stations to be any greater than the separation distance between ground stations and FSS stations. Accordingly, the Commission adopts a minimum separation distance 10 km between proposed aeronautical ground stations and any registered fixed point-to-point transmitter or FSS earth station, Federal or non-Federal, in the absence of a coordination agreement with the fixed station or FSS earth station operator.

35. Commenters in the record evidenced significant concern regarding protection of EESS sensors above 86 GHz from harmful interference due to spurious emissions from the 80 GHz band. The Commission sought comment on what interference mitigation measures might be necessary to protect EESS services operating in the 86–92 GHz band. CORF, ESA/EUMETSAT, and the World Meteorological Organization suggest that the OOBE limits in the Commission's rules should be updated to conform to the standard set forth in ITU-R Resolution 750. The Federal Agencies, based on an independent analysis incorporating specific details of Aeronet's proposed system, recommend an OOBE

limit of -38.5 dBW in any 100 megahertz of the passive band 86–92 GHz for ground-to-air transmissions.

36. The Commission finds the recommendation of the Federal Agencies to be persuasive. The Commission acknowledges that this OOBE limit is slightly more lenient than that urged by CORF and others. However, the Federal Agencies' analysis takes into account specific characteristics of Aeronet's proposed system. The Commission is therefore confident that their resulting conclusions are sufficient to adequately protect EESS operations. The Commission adopts an OOBE limit of -38.5 dBW in any 100 megahertz of the passive band 86–92 GHz for ground-to-air transmissions.

37. *Minimum and Maximum Elevation Angles.* In the *70/80/90 GHz NPRM*, the Commission sought comment on a minimum elevation angle of five degrees for transmissions from ground stations, consistent with the parameters in Aeronet's initial petition. Some commenters suggest that lower elevation angles, such as three or even 1.5 degrees, would be sufficient to prevent harmful interference. Hughes argues that lower elevation angles might require larger separation distances between these aeronautical ground stations and FSS ground stations, thereby hampering future deployment of FSS service. Geneva Communications is generally supportive of some minimum elevation angle in order to protect incumbent Fixed users, and FWCC supports a 5 degree minimum specifically. Loon argues that any minimum elevation angle would favor some systems or business models over others, and thereby restrict competition. Comsearch's analysis of the potential impact of Aeronet's proposed service on other services in the 70/80/90 GHz bands concludes that a minimum elevation angle of five degrees significantly mitigates the potential for interference into fixed point-to-point links. Aeronet subsequently indicated that a minimum elevation angle of five degrees could impact deployment timing and costs compared to a lower angle such as three degrees.

38. The Commission adopts a minimum elevation angle of five degrees for ground stations in this aeronautical service. This is consistent with Aeronet's initial petition and with the record before us. The Commission notes that the Federal Agencies Clarification Letter stated that one study initially conducted by the Federal Agencies assumed 3 degree minimum elevation angles. However, in the record before the Commission, Aeronet has only proposed a 5 degree minimum elevation angle, both in its own Petition and in studies that Aeronet commissioned. The OOBE limit of -38.5 dBW in any 100 megahertz of the passive band 86–92 GHz for ground-to-air transmissions, as recommended in the Federal Agencies

Clarification Letter, accounts for a 5 degree minimum elevation angle.

39. The Commission finds Loon's argument against any minimum elevation angle unpersuasive. Elevation angle is routinely an area of potential concern in bands where terrestrial service coexists with services operating at altitude; for example, part 25 of the Commission's rules, which provides the default rules for satellite operations, requires that satellite earth stations not transmit at elevation angles below five degrees in any band shared with a terrestrial radio service. Adopting a similar restriction on aeronautical services is motivated by similar interference protection concerns and remains a technology-neutral requirement. Given the concerns raised in the record about lower elevation angles, the Commission concludes that five degrees is the most appropriate value. That said, the Commission recognizes the benefits to efficient spectrum use, and ultimately consumers, of permitting parties to agree to less stringent interference mitigation measures than required under its rules. Accordingly, WTB will consider any request for waiver of this rule through the Commission's existing regulatory processes, subject to coordination with NTIA to ensure that Federal incumbents are protected from harmful interference and, as Aeronet suggests, "coordination with other potentially impacted parties based on real-world data."

40. The Commission also adopts a maximum elevation angle of forty-five degrees for aeronautical ground stations. Though this parameter was not included in Aeronet's petition, it is the maximum elevation angle used by the Federal Agencies in their analysis of potential harmful interference to Federal operations, and these assumptions about likely operational parameters were based on input from Aeronet. Because this analysis shows that elevation angles of up to forty-five degrees can (under certain other parameters) coexist successfully with Federal operations, and because the Commission lacks evidence in the record that transmissions above that angle of elevation will not cause harmful interference to Federal or other satellite operations, the Commission adopts a maximum elevation angle of forty-five degrees.

41. Together, these technical parameters and interference mitigation measures will ensure that operators in this aeronautical mobile service will be able to successfully operate, while also protecting operators in other services.

**b. Transmissions Between Aircraft In Flight**

42. Air-to-air transmissions present a unique set of characteristics in terms of the potential for interaction with other services, in both the same and adjacent bands, and accordingly, considerable attention has been paid to how harmful interference from such transmissions might be avoided. In the *70/80/90 GHz NPRM*, the Commission sought comment generally on potential interference mitigation measures. Many commenters raised concerns about the potential for harmful interference into other services, particularly RAS sites above 86 GHz. In response to these concerns, Aeronet, Comsearch, and other commenters suggested a variety of potential mitigation measures. In particular, the Federal Agencies submitted a report with both suggested interference mitigation measures and underlying analysis supporting them, which they suggest would be sufficient to protect Federal operations both in the 70/80 GHz bands and in adjacent bands from harmful interference from air-to-air transmissions.

43. After reviewing the record, and as discussed in more detail below, the Commission adopts the following technical and operational restrictions on transmissions between aircraft in flight, in order to reduce the risk of harmful interference to other services. Air-to-air transmissions will be authorized in both the 70 GHz and 80 GHz bands. The Commission establishes an OOBE limit of -29.7 dBW in any 100 megahertz of the passive band 86–92 GHz, to protect EESS (passive) operations. In the 80 GHz band, the Commission sets a maximum allowed EIRP signal level towards any of a specified list of RAS sites, varying by transmission frequency and distance from the site. In the 70 GHz band, the Commission adopts a similar limit on EIRP signal levels toward specified military installations. Finally, the Commission adopts both altitude restrictions and a minimum slant path distance requirement in order to reduce the risk of harmful interference to in-band services, particularly fixed point-to-point links.

44. Several commenters raised concerns in the record that air-to-air transmissions in the 80 GHz band might produce unwanted emissions into the band above 86 GHz that might cause harmful interference to services in that band, particularly RAS observatories and EESS operations. The Commission agrees with commenters on the importance of protecting RAS and EESS operations in the 86–92 GHz band. However, based on the analysis by the Federal Agencies, the Commission concludes that the interference mitigation measures the Commission adopts, which include restrictions on transmissions in the direction of RAS sites, are sufficient to allow air-to-air transmissions in both the 70 GHz and 80 GHz bands.

45. In the *70/80/90 GHz NPRM*, the Commission sought general comment on what interference mitigation measures might be necessary to protect EESS and RAS services operating in the 86–92 GHz band. Among the measures proposed by commenters relating to air-to-air transmissions were limiting those transmissions to the 70 GHz band and updating the OOBE limits to reflect recent ITU standards. Several commenters also discussed the need for any air-to-air transmissions to avoid pointing directly at an RAS receiver. The Federal Agencies' analysis recommends an OOBE limit of -29.7 dBW in any 100 megahertz of the passive band 86–92 GHz for air-to-air transmissions in order to protect EESS sensors, and a set of restrictions on EIRP levels toward any RAS site depending on the distance of the transmitter to the site. Aeronet has represented both in the Commission's record and to the Federal Agencies that their proposed system has the capability to automatically avoid transmission towards specified stationary areas or coordinates corresponding to RAS sites, which would enable them to comply with such a requirement.

46. The Commission adopts an OOBE limit of -29.7 dBW in any 100 megahertz of the passive band 86–92 GHz for air-to-air transmissions, as suggested by the Federal Agencies. The Commission also adopts a requirement that air-to-air transmissions, in both the 70 GHz and 80 GHz bands, not take place within the main beam of an RAS observatory, and that if this cannot be assured, no transmissions should take place within the radio horizon of the observatory. This restriction was also suggested by the Federal Agencies. The Commission adopts these requirements in order to protect passive services in the adjacent bands (i.e., 76–81 GHz, and above 86 GHz). The Federal Agencies' analysis uses ITU recommendations as their starting point, and comprehensively considers various factors that may influence both harmful interference from aeronautical operations specifically, and aggregate interference from those operations, in addition to previously authorized services. Accordingly, the Commission concludes that the resulting recommendations will be sufficient to protect EESS operations.

47. The Commission takes protection of RAS operations very seriously, and accordingly assign significant weight to the concerns expressed in the record, and especially in the Federal Agencies' analysis, which discusses protection of RAS operations in detail. In order to safeguard these operations, the Commission will follow the recommendations of the Federal Agencies in requiring the following interference protection measures. First, as a general matter no transmissions may occur within the main

beam of an RAS station. In addition, aircraft within the radio horizon of any RAS station must limit the EIRP level towards the RAS stations of any air-to-air transmission, as set forth in Fig. 1.

**Fig. 1: List of Maximum Allowable EIRP levels toward RAS sites, in dBW**

| Frequency (GHz) | Horizontal Distance (km) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 325 | 350 | 375 |
| 81 | -11.2 | -8.8 | -6.5 | -4.2 | -1.5 | 1.1 | 3.9 | 6.7 | 10 | 13.5 |
| 82 | -11.5 | -9.2 | -6.9 | -4.6 | -2 | 0.5 | 3.2 | 6 | 9.2 | 12.6 |
| 83 | -11.7 | -9.5 | -7.3 | -5 | -2.4 | 0 | 2.7 | 5.4 | 8.6 | 11.9 |
| 84 | -11.9 | -9.7 | -7.5 | -5.3 | -2.8 | -0.4 | 2.3 | 4.9 | 8 | 11.3 |
| 85 | -12.1 | -9.9 | -7.8 | -5.5 | -3 | -0.7 | 1.9 | 4.5 | 7.6 | 10.8 |
| 86 | -12.2 | -10 | -7.9 | -5.7 | -3.3 | -0.9 | 1.7 | 4.2 | 7.3 | 10.5 |

48. In addition to concerns regarding adjacent band services, the Federal Agencies also raised concerns about potential harmful interference to co-primary services in the 70 GHz band. Protection of fixed point-to-point links, both Federal and non-Federal, is addressed below. For protection of Federal FSS operations, the Federal Agencies suggest that, similar to protections for RAS stations, EIRP levels from air-to-air transmissions within 375 km of a specified military installation should not exceed 20 dBW/1000 megahertz toward that installation, unless the aeronautical operator has coordinated some other allowable level with the Department of Defense. In response to the *Refresh Public Notice*, no commenter objects to these interference mitigations measures, nor argues that they are insufficient to protect co-primary services in the 70 GHz band. As with protections for RAS operations, the Commission finds the Federal Agencies' analysis on this point persuasive, particularly since no other commenter touches on the interest of Federal FSS operations. Accordingly, the Commission adopts the suggested requirement that air-to-air transmitters within 375 km of any of the specified military installations[3] must limit the EIRP of their transmissions to 20 dBW toward the military installation site.

49. *Altitude Restrictions*. In its petition for rulemaking, Aeronet specified that its proposed service would operate only with aircraft at altitudes between 10,000 and 50,000 feet. The Commission does not seek specific comment in the *70/80/90 GHz NPRM* on this point. DSA suggested that altitude restrictions are unnecessary because the risk of interference into other services is already low, while Loon

[3] This list, which includes specific coordinates for each site, may be found in the Final Rules of the *Report and Order* at 47 CFR 101.1528(c). The Department of Navy also seeks to add an additional FSS site in Miramar, CA, which is not currently reflected in US389, to the list of protected sites in the Commission's part 101 rules. The Commission is not taking any action in this proceeding to modify US389, and thus defer on this request at this time.

argued against any altitude caps on the theory that they would be harmful to potential competition. Geneva Communications suggests that altitude restrictions are unnecessary so long as links are adequately and dynamically coordinated. FWCC supports a restriction to between 10,000 and 50,000 feet of altitude.

50. The Commission rejects Loon's assertion that altitude restrictions favor certain technologies or business models over others. The record demonstrates that, together with other restrictions, air-to-air transmissions between 10,000 and 50,000 feet may be accomplished without harmful interference to incumbent and adjacent operations; it does not demonstrate that transmissions at higher or lower altitudes would be similarly successful. As the Commission is unpersuaded that mandating dynamic coordination of all air-to-air links is necessary, the Commission rejects Geneva Communications' argument as well. Consistent with Aeronet's petition, the Commission adopts a minimum altitude of 10,000 feet for all air-to-air transmissions in these bands, and a maximum altitude of 50,000 feet. Together with the minimum slant path distance requirement that the Commission also adopts, these altitude restrictions will reduce the risk of harmful interference into other services by limiting the area on the ground with line of sight to the airborne transmitter, restricting the angle at which air-to-air transmissions may enter receivers on the ground, and setting a minimum vertical distance (and therefore a minimum amount of atmospheric attenuation) between air-to-air transmissions and both terrestrial and satellite services.

51. *Minimum Slant Path Distance.* In the *70/80/90 GHz NPRM*, the Commission asked what mitigation measures might be necessary to address the risk of harmful interference from air-to-air transmissions between aircraft of significantly different altitudes. That risk of interference arises from the resulting steep angle of the signal, and therefore the increased risk that the transmission ultimately illuminates a receiver in another service, especially a fixed point-to-point receiver along the boresight. Aeronet and Comsearch suggest that a minimum slant path distance would reduce any potential harmful interference from air-to-air links. Qualcomm argues that a minimum horizontal distance between aircraft would be sufficient to render potential harmful interference into fixed links negligible. No commenters argue against adopting a minimum separation between aircraft. Given the state of the record on this point, the Commission adopts a minimum slant path distance of 50 kilometers between aircraft involved

in air-to-air transmissions.

### c. Transmissions Between Ships, Shore, and Aerostat Stations

52. The record generally supports technical and operational restrictions on transmissions to and from ship, shore, and aerostat stations that are parallel to those adopted for airborne transmissions. Shore-to-ship transmissions are only permitted in the 70 GHz band, and ship-to-shore transmissions are only permitted in the 80 GHz band. Shore-to-aerostat transmissions and aerostat-to-ship transmissions are only permitted in the 70 GHz band. Aerostat-to-shore transmissions are only permitted in the 80 GHz band. The Commission adopts an OOBE limit of -29.7 dBW in any 100 megahertz of the passive band 86–92 GHz for ship-to-shore and aerostat-to-shore transmissions in order to protect EESS (passive) operations.

53. Ship-to-ship communications are limited to ships located more than 30 km offshore, or closer only where the main beam of the transmit antenna is oriented at least 15 degrees away from any point on the shore. Ship stations and aerostat stations must only operate when there is a minimum separation of 150 km to the Federal facilities listed in table 3 to § 101.1528(c)(1) of the Final Rules in this *Report and Order*, absent a coordination agreement with the Federal operator. Shore-to-ship, shore-to-aerostat, aerostat-to-shore, and ship-to-shore transmission must only occur between stations that are located at least 10 km from the Federal military installations listed in table 4 to § 101.1528(c)(2) of the Final Rules in this *Report and Order*, absent a coordination agreement with the Federal operator. Ship-to-shore, shore-to-ship, shore-to-aerostat, aerostat-to-ship, and aerostat-to-shore operations must coordinate with Federal FS operations using the NTIA web-based coordination mechanism to prevent interference. The Commission notes that ship-to-aerostat operation has not been sufficiently studied, and thus is not permitted at this time, although the Commission seeks comment in the *Further Notice* below on its potential implementation. Aeronet, through filings submitted in the record, has outlined the important role of bidirectional transmissions between ships and aerostats to the two-way maritime broadband services otherwise authorized in this *Report and Order*. During the pendency of the *Further Notice*, WTB will consider requests for waiver with respect to specific ship-to-aerostat implementation deployment proposals through the Commission's existing regulatory processes, subject to coordination with NTIA to ensure that Federal incumbents are protected from harmful interference and coordination

with any other potentially impacted parties.

54. The same engineering principles that underpin the Commission's adoption of technical and operational restrictions for transmissions between aircraft and ground stations and aircraft in flight serve as a baseline in the maritime context as well, subject to certain modifications as set forth herein and in the Final Rules of this *Report and Order*. For example, the Commission clarifies that the Final Rules do not establish a minimum elevation angle in the maritime context. Opponents of transmissions between ships, shore, and aerostat stations predominantly assert the need for further examination of whether incumbent or future operations in the bands might suffer interference from by maritime operations. The exhaustive TIG process led by the Federal Agencies provides the requested examination. Each of the restrictions described above finds specific support in the collective Federal Agencies Letter, reflecting extensive interagency collaboration—collaboration focused in part on ensuring non-interference with current and future uses of the bands in question—as promised by the Commission in the *70/80/90 GHz NPRM*. No parties objected to adopting the proposed maritime regime the Commission describes above following the solicitation of comment on the Federal Agencies Letter in the Commission's *Refresh Public Notice*. The Commission finds that the combination of the: (1) Commission's own engineering expertise; (2) initial general support for a maritime regime found in responses to the *70/80/90 GHz NPRM*; (3) further examination of specific analyses undertaken in the Federal Agencies Letter, and the studies underpinning it; and (4) silence on maritime issues in particular in the *Refresh Public Notice* comment cycle, demonstrate that the above-described regime for transmissions between ships, shore, and aerostats will protect current and future operations both in the 70 GHz and 80 GHz bands, and in adjacent bands.

### B. Facilitating Use of the Bands for Backhaul

55. To promote more intensive use of spectrum in the 70 GHz and 80 GHz bands, including use for backhaul for high-capacity 5G service, the Commission adopt several changes to its antenna standards that will allow licensees to use smaller, lower-cost antennas in these bands, and the Commission adopt a channelization plan for the band.

56. *Antenna Standards*. The *70/80/90 GHz NPRM* proposed several changes to the antenna standards for the 70 GHz and 80 GHz band to promote flexibility. In particular, the *70/80/90 GHz NPRM*

proposed to reduce minimum antenna gain from 43 dBi to 38 dBi while retaining the requirement to proportionally reduce maximum EIRP in a ratio of 2 dB of power per 1 dB of gain. It also proposed to reduce the co-polar and cross-polar discrimination requirements applicable to 70 GHz and 80 GHz band antennas. Further, the *70/80/90 GHz NPRM* sought comment on whether to allow +/- 45 degree polarization (also known as slant polarization) and whether to adopt a second, more flexible set of antenna standards in these bands. Commenters generally supported reducing antenna gain and co-polar and cross-polar discrimination requirements.

57. Although the Commission does not regulate the size of antennas directly, minimum antenna size is constrained by technical factors including the intended operating bands and requirements governing beamwidth, gain, and polarization discrimination. Based on the Commission's analysis of the record, the Commission determine to relax those requirements for the 70 GHz and 80 GHz bands to standards more in line with the requirements for point-to-point operations for other part 101 bands. The Commission acknowledge Fiberless Networks' concern that "[a]ny reduction in antenna sizes must ultimately impact the number of wireless links using the 71–76 and 81–86 GHz bands that may be deployed in any metro area," but the Commission are persuaded by the FWCC's long-stated advocacy that such changes "will allow for the use of smaller, lighter, lower cost, less susceptible to pole sway, and more visually attractive antennas" that may enable more intensive use of the 70 GHz and 80 GHz bands for point-to-point backhaul services. Additionally, commenters agree that relaxing these antenna standards will also enable the use of smaller antennas for backhaul that will be needed to facilitate densified 5G networks. Accordingly, the Commission raise the maximum beamwidth to 2.2 degrees and reduce the minimum antenna gain to 38 dBi for antennas in the 70 GHz and 80 GHz bands. In order to maintain consistency and minimize the risk of interference, the proportional power reduction requirement will continue to be applicable to antennas in these bands with a gain less than 50 dBi down to the new minimum antenna gain of 38 dBi. Lower-gain antennas have more energy in their sidelobes as compared to a higher-performance antenna, so imposing a proportional reduction in EIRP for antennas with a gain less than 50 dB helps to compensate for the additional power in the sidelobes—thereby ensuring that a lower-performance antenna does not create any greater risk of off-axis interference than a higher-performance antenna.

58. The Commission also adopt its proposal to remove the co-polar discrimination requirement below 5 degrees and modify the cross-polar discrimination requirements below 5 degrees to 21 dB. Some commenters argue that both the co-polar and cross-polar discrimination requirements are obsolete and propose eliminating those requirements entirely. FWCC contends that some of the smaller, lighter antennas its members contemplate using cannot meet the existing co-polar requirement. In order to maximize the flexibility the Commission seek to achieve by relaxing the antenna standards, the Commission eliminate the co-polar discrimination requirement at angles less than 5 degrees. However, the Commission decline to eliminate the cross-polar discrimination requirements below 5 degrees in their entirety. The Commission agree with commenters, including the third-party database manager Comsearch, that cross-polar discrimination requirements are proven to be effective in maximizing frequency reuse in the 70 GHz and 80 GHz bands. The Commission agrees with Comsearch that reducing the cross-polar discrimination requirement for angles less than 5 degrees to 21 dB brings its rules closer to conformity with international standards without sacrificing the frequency reuse advantages of having some cross-polar requirement. The Commission agree with Comsearch that a cross-polar discrimination requirement of 21 dB is not "difficult to meet[.]"

59. Further, the Commission adopt corresponding changes to the co-polar and cross-polar discrimination requirements at angles between 5 degrees and 180 degrees. Physics dictates that smaller antennas will have less sidelobe suppression. Therefore, corresponding adjustments to the discrimination requirements between 5 and 180 degrees are also necessary to facilitate the use of smaller antennas. FWCC proposed antenna standards for this band that are consistent with the Commission's proposed minimum gain of 38 dbi and maximum beamwidth of 2.2 degrees and also proposed co-polar and cross-polar discrimination values for angles between 5 degrees and 180 degrees. FWCC's proposals are consistent with ESTI Class 3 antenna standards, and are supported by the 5G Wireless Backhaul Advocates and Comsearch. Comsearch emphasizes that it is appropriate to provide antenna performance requirements between 5 and 180 degrees, as proposed by FWCC. The Commission believe that the changes proposed by FWCC and the 5G Backhaul Advocates strike a balance, allowing for the use of smaller antennas which will promote and expedite backhaul deployment, while also preserving an appropriate co-polar and cross-polar advantage between paths to promote frequency re-use.

60. In the *70/80/90 GHz NPRM*, the Commission sought comment on a proposal to allow +/- 45 degree polarization (slant polarization) in the 70 GHz and 80 GHz bands. At this time, the Commission decline to modify its rules to adopt slant polarization because the Commission agree with most commenters that slant polarization will increase the risk of interference and make the coordination of links more difficult. As Comsearch notes, allowing slant polarization would "take away the cross-polarization advantage between paths" which has "proven to be effective in maximizing frequency reuse in the 70 and 80 GHz bands . . . ."

61. The Commission also decline to adopt a second category of antenna standards for the 70 GHz and 80 GHz bands. The Commission's rules for some other services regulated under part 101 allow for two categories of antennas, Category A and Category B; Category A performance standards are more stringent than Category B.[4] In the *70/80/90 GHz NPRM*, the Commission sought comment on whether to adopt a similar framework for the 70 GHz and 80 GHz bands by designating the existing antenna standards the "Category A" standards and adopting new, less restrictive "Category B" standards. Although some commenters, including Scientel Solutions and T-Mobile, support adding a Category B standard that does not exist for these bands in the current rules, others, including 5G Americas, Ericsson, and Nokia, do not believe a Category B standard is necessary. Comsearch argues that there is no reason to define two categories of antennas because database managers would not be able to compel antenna upgrades based on predicted interference. The Commission also agree with commenters that adding a Category B standard is unnecessary, given its decision in this *Report and Order* to allow smaller antennas in these bands.

62. *Channelization Plan*. The *70/80/90 GHz NPRM* sought comment on whether adopting a channelization plan would promote more efficient use of the 70 GHz and 80 GHz bands. It further asked about what channel plan should be considered, noting the existence of the plan contained in ITU Recommendation F.2006—see International Telecommunications Union (ITU), Recommendation ITU-R F.2006, "Radio-Frequency Channel and Block Arrangements for Fixed Wireless Systems Operating in the 71–76 and 81–86 GHz Bands" (2012), https://www.itu.int/dms_pubrec/itu-r/rec/f/R-REC-F.2006-0-

[4] Category B antennas may be used in areas not subject to frequency congestion. Category B antennas must be replaced if they are shown to cause interference to (or receive interference from) any other authorized station where a higher performance antenna is not likely to cause such interference.

201203-I!!PDF-E.pdf (ITU-R F.2006)—which the Commission describe in greater detail below. The *70/80/90 GHz NPRM* also solicited comment on a range of issues including the impact of a channel plan on existing equipment, whether to continue to apply the standard emission limit rules in section 101.1011, whether any specific channel plan and direction of service would be particularly conducive to protecting the other co-primary services from interference, and the costs and benefits of channelization.

63. The Commission are persuaded that the Commission should adopt a channelization plan consistent with ITU-R F.2006. The Commission acknowledge that the Commission decided in 2003 that a specific channel plan was unnecessary in the context of adopting new rules to facilitate greater use of the bands by nascent fixed services. Given the development of these fixed services since 2003 and its adoption of rules to permit additional services into the band, the Commission agree with commenters that a standardized channel plan will make interference mitigation between licensees easier to manage. Adopting the ITU F.2006 plan will also harmonize the Commission's rules with international standards, and is consistent with a majority of commenters' recommendations.

64. After reviewing the record, including responses to the *HAPS Public Notice* and *Refresh Public Notice*, while some commenters are neutral on the issue of channelization others specifically state that if the Commission introduces new services into the band—such as the services contemplated by Aeronet—there will be a greater need to have a standardized channel plan in order to make interference mitigation between licensees more manageable. On balance, most commenters support adopting a standardized plan specifically if new services are introduced into the band. Moreover, Aeronet supports the adoption of a standardized channel plan.

65. There is near-unanimous agreement among commenters that if the Commission adopts a channel plan, the Commission should adopt a plan consistent with ITU-R F.2006, which provides different channel sizes from 250 megahertz up to 5 gigahertz, and includes a plan for 1.25 gigahertz segmentation. This channelization plan is consistent with what the Commission proposed, but ultimately did not codify in the original 70–80 GHz rulemaking. Comsearch notes that a majority of licensees already conform with the ITU-R F.2006 channel plan. Even commenters that advocate against adopting a standardized channel plan, such as WISPA, support adopting the ITU F.2006 channel plan if the Commission decides that it should adopt a standardized plan.

66. To provide adequate lead time for manufacturers to modify their equipment lines to comply with the new channel plan, the Commission will make the new channel plan effective on September 1, 2024. Considering that there are incumbents in the band who have deployed under the current rules and may not be operating consistent with a channel plan that the Commission adopt, the Commission will permit licensees that are registered prior to the effective date of the new channel plan to continue to operate under nonconforming channel plans as long as their pre-existing operations remain in good standing. With the exception of de minimis modifications to registered links discussed below, all links registered on or after September 1, 2024, will be required to comply with the new channel plan.

### C. Improving the Link Registration System

67. In the *70/80/90 GHz NPRM*, the Commission solicited input on whether it should make changes to the link registration rules for the 70/80/90 GHz bands.[5] Specifically, the Commission sought comment on how to amend its rules to improve the accuracy of the link registration database. The Commission also asked whether it should require licensees in these bands to certify that their links have been timely constructed—and, if so, how an efficient and effective certification process would operate. Among other things, the Commission asked whether "certifications should be filed when the links become operational, at any time prior to the construction deadline, or whenever a licensee seeks to renew its license?" The Commission also sought comment on whether to allow de minimis modifications to certain information filed in the registration database.

#### 1. Construction and Operational Status

68. To promote the efficient use of the high-capacity 70/80/90 GHz bands, in this *Report and Order* the Commission adopt a requirement that licensees certify that each link is constructed and operating within 12 months of successful registration in the link registration system (LRS) administered by third-party database managers. Under the Commission's rules in place since 2003, licensees must construct their links within 12 months of registering them in the LRS and failure to timely begin operation means the authorization cancels automatically. Under the hybrid license/registration approach adopted

[5] The 90 GHz band has different antenna rules, but the same link registration process as the 70 GHz and 80 GHz bands. Although in this *Report and Order* the Commission does not modify the antenna rules in the 90 GHz band, in the Commission's consideration of changes to the link registration process, the Commission does include the 90 GHz band to maintain a harmonized approach to link registration for all of the bands included in the link registration system.

for these bands, however, the Commission decided "at [that] time" not to require licensees to affirmatively report link construction and instead relied on licensees to ask a database manager to remove unconstructed links from the database. As such, the Commission instructed the database managers to remove a link from the registry if it is found to be unconstructed after the required timeframe. The Commission note that in 2003 the bands were "essentially undeveloped and available for new uses" and that the Commission reserved the discretion to revisit this issue if experience indicated that additional measures were necessary.

69. As in 2003, the overarching purpose of the Commission's requirements concerning link construction, as well as modification and discontinuance, is to ensure that spectrum is put to use and to maintain the "integrity of the information in the relevant databases by correctly reflecting the actual record concerning these issues." Based on the Commission's experience, including the development of the bands since 2003, and the record before us, the Commission finds that requiring licensees to certify in the LRS that each link is timely constructed will significantly improve the accuracy of the database, thereby increasing opportunities for additional, efficient use of the bands. Failure to begin operations in a timely manner pursuant to a part 101 authorization results in the automatic cancelation of an authorization.

70. In the 70/80/90 GHz bands, the nationwide license serves as a prerequisite to registering links, each registration in the LRS is the licensee's authorization to operate the individual link, and the 12-month construction period commences on the registration date of each individual link. Because 70/80/90 GHz links are registered in the LRS, the provision in paragraph (f) stating that "construction of any authorized facility or frequency must be completed by the date specified in the license" is inapplicable to 70/80/90 links. Under the current rules, "[f]ailure to timely begin operation means the authorization cancels automatically" as of the construction deadline. Similar to the timeline for construction notifications filed in ULS, however, the Commission will allow 70/80/90 GHz licensees 15 days after the 12-month construction deadline for each link to certify in the LRS that the link was timely constructed and operating. Accordingly, if a 70/80/90 GHz licensee does not certify in the LRS within 15 days after the 12-month construction deadline for a link, the link will be deemed to be unconstructed and the licensee's authority to operate the link shall be terminated automatically without further Commission

action as of the 12-month construction deadline for the link. The Commission also agrees with commenters that after the certification requirement becomes effective, it should apply to all uncertified links even if the 12-month construction deadline date occurred prior to the effective date of the certification requirement. For uncertified links registered 12 months or longer before the effective date, licensees will have until 15 days after the effective date to certify that their links were constructed on or before the effective date. Thus, for uncertified links registered less than 12 months before the effective date, licensees will have to file a certification within 15 days from the end of the 12-month construction period following registration.

71. Once the certification requirement is in effect, the Commission instructs the third-party database managers, as a matter of database accuracy and integrity, to remove uncertified registrations from the LRS that have terminated automatically under the Commission's rules. Because licensees will have until 15 days after the 12-month construction deadline to certify in the LRS that a link is constructed and operating, the Commission instructs database managers to remove a link from the LRS on the 16th day after the 12-month construction deadline for a link if the licensee has not certified in the LRS that the link was timely constructed and operating.

72. Imposing the certification requirement on licensees and having the third-party database managers update the LRS accordingly will allow all licensees, and the Commission, to track link cancellations through the LRS. Parties considering the 70/80/90 GHz bands and licensees seeking to register links after implementation of this requirement will have a more accurate database to use to judge spectrum availability. In this setting, if a licensee's authority to operate a link is automatically terminated because the construction requirement was not met, the licensee will not be barred from attempting to register the link again, and if successful, constructing it later. The licensee, however, will lose the original registration date for the purpose of interference protection procedures.

73. There is broad support in the record for implementing the certification requirement. FWCC argues that construction certifications will help maintain a reliable database at a low cost to licensees. Commenters broadly agree that the database should consist only of links that are actually constructed or that have been successfully registered but are within their one-year construction period, and that requiring construction certifications would be an effective way to maintain an accurate database

and promote efficient access to the bands. Other commenters, including Comsearch, agree that the existing database managers are well suited to administer the certification requirement. Micronet's database provides information about links that have been registered and not constructed, but there is no requirement that Micronet provide this information and there is no requirement that licensees inform Micronet when links are built. Therefore, links that appear in Micronet's database as unconstructed may be constructed.

74. Although some parties would have the Commission manage construction certifications through ULS, the Commission believes that the hybrid license/registration approach that has governed these bands since the database managers developed and began operating the LRS in 2005 has worked reasonably well and should not be displaced. Industry members are already accustomed to working with the database managers on spectrum management matters and have established access to the database managers' platforms. The Commission agrees with FWCC and Comsearch that using ULS for certification would add unnecessary complexity to the link registration process. The Commission agrees, however, with commenters who suggest that additional measures are warranted to ensure that registered links remain operational on an ongoing basis long after satisfaction of the 12-month construction deadline. Accordingly, when a 70/80/90 GHz band licensee seeks to renew its nationwide license, the Commission will require the licensee to certify as part of the license renewal application that each link registered under the license more than twelve months prior to the filing date of the renewal application is constructed and operating on an ongoing basis as of the filing date of the license renewal application. The Commission disagrees with AT&T that requiring licensees to certify every ten years that they are still operating their registered links is unnecessary given that the Commission is requiring licensees to certify each link shortly after the 12-month construction deadline. The Commission clarifies, however, that the Commission is not requiring renewal applicants to "list links, whether constructed or not, in renewal applications for 70/80/90 GHz licenses."

75. *Implementation Matters.* The Commission authorizes and directs WTB to consult each database manager on the timing of modifications to the LRS necessary to accommodate rule changes. WTB will also announce by public notice the details and dates for implementing a construction certification requirement. Additionally, the Commission understands that each database manager

periodically sends its registrants e-mail reminders of their upcoming and recently past construction deadlines and that each database manager plans to send e-mail alerts to its relevant registrants about these rule changes. The Commission applauds the database managers' past efforts to improve the accuracy of the database and encourage them to continue sending e-mail alerts to licensees. The Commission emphasizes, however, that each licensee is responsible for timely filing its construction certifications in the LRS regardless of whether a courtesy reminder e-mail may have been sent or received. Finally, the Commission reminds licensees that they should only certify as constructed links that are operational, and that non-operational links should be deleted from the database. Licensees are reminded that links that are not actually constructed by the construction deadline cancel automatically on the date of the construction period expires, and are not entitled to first-in-time protection regardless of whether they may appear in the registration database.

### 2. De Minimis Modifications to Registrations

76. The *70/80/90 GHz NPRM* sought comment on whether licensees should be allowed to amend their registered links without losing first-in-time status—i.e., on what date should a link be considered registered and given protected status for purposes of these rule—and what amendments, if any, should be allowed without losing first-in-time status. The Commission finds support in the record for allowing de minimis modifications to registrations that are exclusively for the purpose of repairing or replacing installed and operating equipment, provided that there are no changes to any registered technical parameters that would change the potential for a link to cause or receive interference. Modifications that are consistent with these requirements can be implemented without affecting a registrant's first-in-time rights for the particular link. Such modifications may be implemented if the modified registration is successful without affecting a registrant's first-in-time rights for the particular link. By allowing these de minimis modifications to registrations without changing the interference-protection date, the Commission allows licensees to maintain the existing operation of their links without sacrificing either the accuracy of the database or the licensee's interference-protection rights. The Commission emphasizes that "de minimis" modifications to registrations that commenters discuss in this proceeding are distinct from the Commission's part 1 rules that govern major or minor modifications to station authorizations. To avoid confusion, the Commission refers to modifications to registrations that

licensees can make without losing first-in-time status as de minimis. Most parties support de minimis modifications to the extent that they will not change the interference landscape, though parties' ideas of what would constitute a de minimis modification differ. Some parties argue that de minimis modifications should include changes to some technical specifications. For example, WISPA argues that minor modifications should include changes to geographic coordinates within +/- 15 meters of latitude or longitude and +/- 3 meters of elevation. Others, however, believe that de minimis modifications should be only those changes that do not affect any technical parameters relevant for coordination. The Commission agrees with commenters that modifications that change "interference potential" should not be treated as de minimis modifications and will result in a new date for first-in-time purposes.

77. The Commission finds that many of the proposals by commenters, such as those involving changes to location, could change the interference landscape and therefor are not de minimis. In addition, changes to parameters that typically would not be considered major in other contexts, like increases to receive antenna height, could make an existing link more susceptible to interference. Given the sensitivity of the first-in-time rights to changes in the interference environment, the Commission believes that it is prudent to define de minimis modifications in this context very narrowly. Based on the Commission's analysis of the comments in the record the Commission will define de minimis modifications as those that meet all of the following criteria: The modification is necessary to repair or replace registered, constructed, and operating equipment; the modification does not increase the EIRP of a digital system or change the EIRP of an analog system;[6] the modification does not increase the channel bandwidth; the modification does not change the power density; the modification does not increase the receiver sensitivity; the modification does not increase the antenna beamwidth; the modification does not increase the antenna gain, except where there is a corresponding reduction transmitter power so that there is no increase in EIRP; the modification does not involve a change to antenna with less off-axis attenuation at any angle; and the modification does not change any other technical parameters not mentioned above.

[6] For analog systems the interference criteria in rule section 101.105 is specified as a C/I ratio, so decreases in EIRP could change the C/I ratio and potentially make a link more susceptible to interference. Therefore, for analog systems any modification that changes the EIRP will not be considered de minimis, and a new date will be applied for first-in-time purposes.

78. Under the definition adopted above, any modification to a registration that could make a link more susceptible to interference or more likely to cause interference will result in a new date for first-in-time coordination purposes. The Commission finds that the limited definition of a de minimis modification adopted in this *Report and Order* will minimize the risk of harmful interference and promote efficient access to these bands.

### D. Other Issues

79. The Commission does not take action at this time on several other issues raised in the Commission's inquiries in this proceeding, or by commenters in the record owing to absence of notice, an inadequate record, or lack of consensus on a path forward. To wit, in the *70/80/90 GHz NPRM,* the Commission sought comment on a proposal relating to authorizing mobile operations on a non-interference basis to fixed operations along the United States' international borders with Canada and Mexico, subject to future international agreements. This specific issue was not addressed by any filers. In the absence of a developed record on this issue, the Commission does not address it at this time.

80. Separately, in the *HAPS Public Notice* WTB sought to supplement the record on the possibility of bringing HAPS and/or other stratospheric-based platform services into the 70/80/90 GHz bands. The record, including analysis provided by the Federal Agencies, contains highly divergent claims regarding the possibility of integrating HAPS operations into the 70/80/90 GHz bands, with limited actual data to support such action. The Commission therefore declines at this time to adopt rules for HAPS operations in the 70/80/90 GHz bands. The Commission does note that any party—including HAPS providers—can engage in operations consistent with the rules of general applicability for aeronautical services adopted in this *Report and Order*.

81. Beginning in *ex parte* presentations, and later in other filings in this docket, SpaceX requested that the Commission amends its rules to allow the registration of FSS earth stations in the third-party link registration database for the 70 GHz and 80 GHz bands. While FSS has a co-primary shared allocation, the Commission has not yet developed service rules for FSS operations in these bands. As FSS operations differ in significant ways from the FS operations that the third-party database system was originally designed to accommodate, adding FSS to this system would likely require development of different coordination parameters, and possibly additional interference mitigation techniques to protect

Federal operations in the bands. The Commission notes that the Commission's rules for authorization of proposed non-Federal fixed terrestrial links in the 71.0–76.0 GHz and 81.0–86.0 GHz bands do not address co-band, non-Federal FSS Earth stations and thus non-Federal terrestrial licensees are not required to analyze the potential for harmful interference to or from a proposed link to non-Federal gateway Earth stations previously authorized or pending in ICFS under the default service rules. Moreover, SpaceX notes that the interference mitigations proposed in the Federal Agencies Letter, which inform the rules to accommodate airborne and maritime point-to-endpoints-in-motion in the third-party database system that the Commission adopts would not be appropriate for FSS operations in the 70 GHz and 80 GHz bands. Without the development of a record on the specifics required to include FSS earth stations in the third-party database, or Federal inter-agency discourse on this prospect, the Commission is not in a position to take this step. However, the Commission seeks further input on these issues in the *Further Notice* portion of this item immediately below.

82. The fact that the Commission is not adding FSS to the third-party database registration system does not impair the ability of FSS operators to continue to deploy and operate new earth stations in the 70/80/90 GHz bands,[7] subject to prior coordination with existing incumbents.[8]

83. In response to certain concerns raised in the record, the Commission emphasizes that the allocations in the 70/80/90 GHz bands have not changed. FSS and FS remain co-primary, and the Commission continues to have policies in place that allow for coexistence. First-in-time priority rights serve as the foundation for such coexistence in the 70/80/90 GHz bands, as they do in other spectrum bands shared by FS and FSS; nothing the Commission adopts disturbs this status quo.

## III. FINAL REGULATORY FLEXIBILITY ANALYSIS

84. As required by the Regulatory Flexibility Act of 1980, as amended (RFA), an Initial

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[7] The Commission notes, for example, that SpaceX has filed earth and space station applications to authorize its operations in the 70/80/90 GHz bands pursuant to the part 25 default service rules, and is currently operating under special temporary authorizations (STAs) pending completion of Federal coordination on its applications for final authorization.

[8] Satellite operations were not yet permitted in the E-band in 2003 when the Commission adopted the license/registration approach for non-Federal terrestrial links. The Commission recognized, however, that there were co-primary satellite allocations in various portions of the E-band and decided to maintain multiple services in the allocation table and address possible sharing criteria in the future stating that "all terrestrial 71–76 GHz and 81–86 GHz band entities are hereby made aware that future operations of satellite and satellite earth stations could be permitted in the 71–76 GHz and 81–86 GHz bands. Once the Commission considers and adopts technical standards for terrestrial and satellite operations to share this spectrum, all licensees will be expected to satisfy these and any other Part 101 requirements."

Regulatory Flexibility Analysis (IRFA) was incorporated into the *Modernizing and Expanding Access to the 70/80/90 GHz Bands, Notice of Proposed Rulemaking (NPRM)* released in June 2020. The Federal Communications Commission (Commission) sought written public comment on the proposals in the *NPRM*, including comments on the IRFA. No comments were filed addressing the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.

### A. Need for, and Objectives of, the Report and Order

85. In the *Report and Order*, the Commission seeks to further its goals of fostering innovation in provisioning broadband and on meeting the rapidly increasing demand for its related services by small and other entities through the adoption of new rules and modernizing current rules for the 71–76 GHz, 81–86 GHz, 92–94 GHz, and 94.1–95 GHz bands (collectively, the 70/80/90 GHz bands).

86. The adopted rules take several approaches towards achieving these goals. One approach is authorizing certain point-to-point links to endpoints in motion in the 70 GHz and 80 GHz bands under the Commission's part 101 rules to further the use of these frequencies for access to broadband services on aircraft and ships. In the *Report and Order*, the Commission authorizes certain point-to-point links to endpoints in motion in the 71–76 GHz (the 70 GHz band) and 81–86 GHz (the 80 GHz band) bands under its part 101 rules. Another approach is updating the Commission's rules to permit the use of smaller and lower-cost antennas to facilitate the provisioning of backhaul service in the 70 GHz and 80 GHz bands, and mandates a channelization plan in those bands. Finally, the *Report and Order* adopted changes to the link registration process in the 70/80/90 GHz bands to promote prompt construction of registered links, thereby fostering more efficient use of this spectrum and improving the accuracy of the link registration database.

### B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

87. There were no comments filed that specifically addressed the proposed rules and policies presented in the IRFA.

### C. Response to Comments by the Chief Counsel for Advocacy of the Small Business Administration

88. Pursuant to the Small Business Jobs Act of 2010, which amended the RFA, the

Commission is required to respond to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration (SBA), and to provide a detailed statement of any change made to the proposed rules as a result of those comments. The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

### D. Description and Estimate of the Number of Small Entities to Which the Rules Will Apply

89. The RFA directs agencies to provide a description of and, where feasible, an estimate of the number of small entities that may be affected by the rules adopted herein. The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction." In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act." A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the SBA.

90. *Small Businesses, Small Organizations, Small Governmental Jurisdictions.* The Commission's actions, over time, may affect small entities that are not easily categorized at present. The Commission therefore describes, at the outset, three broad groups of small entities that could be directly affected herein. First, while there are industry specific size standards for small businesses that are used in the regulatory flexibility analysis, according to data from the Small Business Administration's (SBA) Office of Advocacy, in general a small business is an independent business having fewer than 500 employees. These types of small businesses represent 99.9% of all businesses in the United States, which translates to 33.2 million businesses.

91. Next, the type of small entity described as a "small organization" is generally "any not-for-profit enterprise which is independently owned and operated and is not dominant in its field." The Internal Revenue Service (IRS) uses a revenue benchmark of $50,000 or less to delineate its annual electronic filing requirements for small exempt organizations. Nationwide, for tax year 2020, there were approximately 447,689 small exempt organizations in the U.S. reporting revenues of $50,000 or less according to the registration and tax data for exempt organizations available from the IRS.

92. Finally, the small entity described as a "small governmental jurisdiction" is defined

generally as "governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand." U.S. Census Bureau data from the 2017 Census of Governments indicate there were 90,075 local governmental jurisdictions consisting of general purpose governments and special purpose governments in the United States. Of this number, there were 36,931 general purpose governments (county, municipal, and town or township) with populations of less than 50,000 and 12,040 special purpose governments—independent school districts with enrollment populations of less than 50,000. Accordingly, based on the 2017 U.S. Census of Governments data, the Commission estimates that at least 48,971 entities fall into the category of "small governmental jurisdictions."

93. *Wireless Telecommunications Carriers (except Satellite).* This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular services, paging services, wireless Internet access, and wireless video services. The SBA size standard for this industry classifies a business as small if it has 1,500 or fewer employees. U.S. Census Bureau data for 2017 show that there were 2,893 firms in this industry that operated for the entire year. Of that number, 2,837 firms employed fewer than 250 employees. Additionally, based on Commission data in the 2022 Universal Service Monitoring Report, as of December 31, 2021, there were 594 providers that reported they were engaged in the provision of wireless services. Of these providers, the Commission estimates that 511 providers have 1,500 or fewer employees. Consequently, using the SBA's small business size standard, most of these providers can be considered small entities.

94. *Fixed Microwave Services.* Fixed microwave services include common carrier, private-operational fixed, and broadcast auxiliary radio services. They also include the Upper Microwave Flexible Use Service (UMFUS), Millimeter Wave Service (70/80/90 GHz), Local Multipoint Distribution Service (LMDS), the Digital Electronic Message Service (DEMS), 24 GHz Service, Multiple Address Systems (MAS), and Multichannel Video Distribution and Data Service (MVDDS), where in some bands licensees can choose between common carrier and non-common carrier status. Wireless Telecommunications Carriers (*except* Satellite) is the closest industry with a SBA small business size

standard applicable to these services. The SBA small size standard for this industry classifies a business as small if it has 1,500 or fewer employees. U.S. Census Bureau data for 2017 show that there were 2,893 firms that operated in this industry for the entire year. Of this number, 2,837 firms employed fewer than 250 employees. Thus under the SBA size standard, the Commission estimates that a majority of fixed microwave service licensees can be considered small.

95. The Commission's small business size standards with respect to fixed microwave services involve eligibility for bidding credits and installment payments in the auction of licenses for the various frequency bands included in fixed microwave services. When bidding credits are adopted for the auction of licenses in fixed microwave services frequency bands, such credits may be available to several types of small businesses based average gross revenues (small, very small and entrepreneur) pursuant to the competitive bidding rules adopted in conjunction with the requirements for the auction and/or as identified in part 101 of the Commission's rules for the specific fixed microwave services frequency bands.

96. In frequency bands where licenses were subject to auction, the Commission notes that as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Further, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated. Additionally, since the Commission does not collect data on the number of employees for licensees providing these services, at this time the Commission is not able to estimate the number of licensees with active licenses that would qualify as small under the SBA's small business size standard.

97. *Satellite Telecommunications.* This industry comprises firms "primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications." Satellite telecommunications service providers include satellite and earth station operators. The SBA small business size standard for this industry classifies a business with $38.5 million or less in annual receipts as small. U.S. Census Bureau data for 2017 show that 275 firms in this industry operated for the entire year. Of this number, 242 firms had revenue of less than $25

million. Additionally, based on Commission data in the 2022 Universal Service Monitoring Report, as of December 31, 2021, there were 65 providers that reported they were engaged in the provision of satellite telecommunications services. Of these providers, the Commission estimates that approximately 42 providers have 1,500 or fewer employees. Consequently, using the SBA's small business size standard, a little more than half of these providers can be considered small entities.

98. *All Other Telecommunications*. This industry is comprised of establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Providers of Internet services (e.g. dial-up ISPs) or Voice over Internet Protocol (VoIP) services, via client-supplied telecommunications connections are also included in this industry. The SBA small business size standard for this industry classifies firms with annual receipts of $35 million or less as small. U.S. Census Bureau data for 2017 show that there were 1,079 firms in this industry that operated for the entire year. Of those firms, 1,039 had revenue of less than $25 million. Based on this data, the Commission estimates that the majority of "All Other Telecommunications" firms can be considered small.

99. *Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing*. This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment. The SBA small business size standard for this industry classifies businesses having 1,250 employees or less as small. U.S. Census Bureau data for 2017 show that there were 656 firms in this industry that operated for the entire year. Of this number, 624 firms had fewer than 250 employees. Thus, under the SBA size standard, the majority of firms in this industry can be considered small.

### E. Description of Projected Reporting, Recordkeeping, and Other Compliance

**Requirements for Small Entities**

100. The rule changes adopted in the *Report and Order* will impose some new and/or additional reporting, recordkeeping, or other compliance requirements on small entities who obtain licenses in the 70/80/90 GHz bands. These requirements are consistent with the requirements the Commission has adopted for other mmW bands; as a result, small entities will potentially have less of a learning curve in their efforts to comply with the adopted rules.

101. In 2003, the Commission established service rules for non-Federal use of the 70/80/90 GHz bands through a two-step, non-exclusive licensing regime. Small entities and other applicants obtain a nationwide, non-exclusive license for the entire 12.9 gigahertz of the 70/80/90 GHz bands, and then register individual links in a database administered by third-party database managers. Since 2004, the Wireless Bureau has designated the Commission's entities to be database managers but there are currently two database managers: Comsearch and Micronet Communications, Inc. In order for a link to be registered, it must be coordinated successfully with Federal operations, typically through the National Telecommunications and Information Administration's (NTIA) online, automated mechanism. If a proposed link does not interfere with existing Federal operations then it is given a "green light;" if it may interfere with existing Federal operations, then it is given a "yellow light," indicating that the licensee must file a registration application for the link with the FCC for coordination with NTIA. The "green light" / "yellow light" system protects the sensitive nature of the locations of military installations. Also, the licensee must provide an analysis to the third-party database manager demonstrating that the proposed link will neither cause harmful interference to, nor receive harmful interference from, any previously registered non-government link. Licensees are afforded first-in-time priority for successfully registered links relative to links that are successfully registered at a later point in time. Registered links must be constructed within 12 months of their registration. Under part 101, non-Federal licensees may use the 70/80/90 GHz bands for any point-to-point, non-broadcast service.

102. Many of the rule changes adopted in the *Report and Order* are consistent with and mirror existing Commission policies and requirements used in other part 101 spectrum bands, which the Commission expects will help minimize some of the compliance burdens associated with the adopted rules. For example, while the Commission does add a construction certification requirement that

licensees certify that each link is constructed and operating within 12 months of successful registration in the link registration system (LRS) administered by third-party database managers, small entities with existing licenses in other bands may already be familiar with similar policies and requirements and have the processes and procedures already in place to facilitate compliance, resulting in minimal incremental costs to comply with the Commission's requirements for the 70/80/90 GHz bands. The Commission also adopts de minimis modifications to link registrations, which allow licensees to amend their registered links without losing their first-in-time rights for those links. Adopting this rule allows small and other licensees to maintain the existing operation of their links without sacrificing either the accuracy of the database or the licensee's interference-protection rights. Additionally, the Commission believes small entities will continue to benefit from their ability to obtain more information than was previously available to them, such as access to the third-party databases and FCC rulemakings, but with improvements to the data within the database that will result from the construction certification requirement.

### F. Steps Taken to Minimize the Significant Economic Impact on Small Entities, and Significant Alternatives Considered

103. The RFA requires an agency to provide "a description of the steps the agency has taken to minimize the significant economic impact on small entities . . . including a statement of the factual, policy, and legal reasons for selecting the alternative adopted in the final rule and why each one of the other significant alternatives to the rule considered by the agency which affect the impact on small entities was rejected."

104. In the *Report and Order*, the Commission adopts measures to meet the great demand for wireless broadband connectivity in an efficient and effective manner. While doing so, the Commission is mindful that small licensees and service providers will incur some new and/or additional compliance requirements that may also result in increased costs. In adopting the proposed rules, the Commission weighed the impact of these obligations on small entities against the public interest benefits gained from them and have determined that the benefits outweigh the costs. Both the specific steps the Commission has taken to minimize costs and reduce the economic impact for small entities and the alternatives considered are discussed below.

105. For example, through the adopted rules, the Commission took the step of changing its antenna standards to allow licensees, some of which are small entities, to use smaller, lower-cost antennas in the 70 GHz and 80 GHz bands for 5G backhaul. Taking this approach will allow for more intensive use of these bands by small and other entities, thus allowing them to further develop and expand their businesses. Alternatively, the Commission considered not utilizing this approach, due to a concern that reducing antenna size would impact the number of links using the 71–76 GHz and 81–86 GHz bands in metro areas. However, the benefit of allowing for greater use of the bands outweighed this concern. The Commission also minimized the economic impact on small and other entities through its adoption of the de minimis modification requirement, which ensures that licensees can amend their registrations and not lose their first-in-time status for their registered links, as long as their modifications are consistent with the adopted requirements. The adopted de minimis standard for modifications will be a particular boon to small entities, who may already have limited resources and would likely be disproportionately burdened if their need to repair or replace installed and operating equipment did not change the potential risk of a link causing or receiving interference, yet still caused them to "lose their place in line." The Commission considered, but declined to adopt, proposals from commenters that the Commission determined were beyond a de minimis modification, such as those that would change the interference landscape.

106. The Commission also considered but rejected arguments requiring construction certifications be filed in the Universal Licensing System (ULS). The Commission instead focused on targeted changes to improve efficiency in high-capacity bands critical to accelerating the deployment of 5G services nationwide. The Commission expects its approach of opting to modify existing rules as minimally as possible instead of creating numerous new and/or additional rules, should minimize the economic impact for small entities and promote greater use of the band among all providers.

107. To the extent the cost of complying with these burdens is relatively greater for smaller entities than for large ones, the Commission believes equal application of the rules is necessary to effectuate the purpose of the Communications Act, namely, to further the efficient use of spectrum and to prevent spectrum warehousing. Likewise, equal application of compliance with the Commission's technical rules and coordination requirements for all licensees is necessary for the furtherance of the Commission's goals of protecting the public while facilitating the provision of interference-free services

by licensees.

## IV. ORDERING CLAUSES

108. IT IS ORDERED that, pursuant to sections 4(i), 301, 302, 303(c), 303(f), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 301, 302a, 303(c), 303(f), and 303(r), that this *Report and Order* IS ADOPTED as set forth above.

109. IT IS FURTHER ORDERED that the amendments of the Commission's rules as set forth in Final Rules ARE ADOPTED, effective thirty days from the date of publication in the Federal Register, except for: (1) section 101.147(z)(3), which will take effect on September 1, 2024; and (2) sections 101.63(b), 101.1523(a), (e), and 101.1528 (a)(11), (b)(10), and (d), which contain new or modified information collection requirements that requires approval by the Office of Management and Budget under the Paperwork Reduction Act and will take effect after the Commission publishes a notice in the Federal Register announcing such approval and the relevant effective date(s).

110. IT IS FURTHER ORDERED that the Commission's Office of the Secretary, SHALL SEND a copy of this *Report and Order*, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

111. IT IS FURTHER ORDERED that the Office of the Managing Director, Performance and Program Management, SHALL SEND a copy of this *Report and Order* in a report to be sent to Congress

and the Government Accountability Office pursuant to the Congressional Review Act, 5 U.S.C. 801(a)(1)(A).

**List of Subjects**

**47 CFR Part 0**

Authority delegations (Government agencies); Classified information; Communications; Communications common carriers

**47 CFR Part 101**

Administrative practice and procedure; Communications; Communications equipment; Radio; Reporting and recordkeeping requirements; Satellites; Telecommunications

FEDERAL COMMUNICATIONS COMMISSION

**Marlene Dortch,**
*Secretary,*
*Office of Secretary*.

**Final Rules**

For the reasons discussed in preamble, the Federal Communications Commission amends 47 CFR parts 0 and 101 as follows:

**PART 0 – COMMISSION ORGANIZATION**

1. The authority citation for part 0 continues to read as follows:

**Authority:** 47 U.S.C. 151, 154(i), 154(j), 155, 225, and 409, unless otherwise noted.

2. Effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, § 0.241 is amended by adding paragraph (l) to read as follows:

**§ 0.241 Authority delegated.**

* * * * *

(l) The Chief of the Office of Engineering and Technology is delegated authority, jointly with the Chief of the Wireless Telecommunications Bureau, to establish and administer a process for review of proposed technologies for point-to-endpoint-in-motion communications to aircraft and ships in the 71–76 GHz and 81–86 GHz bands to ensure compliance with the requirements adopted by the Commission.

3. Effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, § 0.331 is amended by revising the introductory text and adding paragraph (g) to read as follows:

**§ 0.331 Authority delegated.**

The Chief, Wireless Telecommunications Bureau, is hereby delegated authority to perform all functions of the Bureau, described in § 0.131, subject to the exceptions and limitations in paragraphs (a) through (d) of this section, and also the functions described in paragraphs (e) through (g) of this section.

* * * * *

(g) *Authority concerning review of certain proposed technologies in the 71-76 and 81-86 GHz bands*. The Chief of the Wireless Telecommunications Bureau is delegated authority, jointly with the Chief of the Office of Engineering and Technology, to establish and administer a process for review of proposed technologies for point-to-endpoint-in-motion communications to aircraft and ships in the 71–76 GHz and 81–86 GHz bands to ensure compliance with the requirements adopted by the Commission. The Chief of the Wireless Telecommunications Bureau is also delegated authority to establish and

administer specific procedures to be followed for coordinating and registering aeronautical and maritime stations and their associated transmissions.

**PART 101 – FIXED MICROWAVE SERVICES**

4. The authority citation for part 101 continues to read as follows:

**Authority:** 47 U.S.C. 154, 303.

5. Delayed indefinitely, § 101.63 is amended by revising paragraph (b) to read as follows:

**§ 101.63 Period of construction; certification of completion of construction.**

* * * * *

(b) For the 70 GHz, 80 GHz, and 90 GHz bands, the 12-month construction period will commence on the date of each registration of each individual link; adding links will not change the overall renewal period of the license. For each individual link, a licensee who commences operations within the construction period must certify in the third-party link registration database, such as those established pursuant to section 101.1523, that the link is constructed and operational. The certification must be filed within 15 days of the expiration of the applicable construction period for each individual link. If operations have begun using some, but not all, of the authorized transmitters, the certification must show to which specific transmitters it applies. After 15 days of the end of the construction period for each individual link, if the licensee has not certified that the link is constructed and operational, the third-party database managers will delete the registration from the database.

* * * * *

6. Effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, § 101.111 is amended by adding paragraph (a)(2)(vi) to read as follows:

**§ 101.111 Emission limitations.**

(a) * * *

(2) * * *

(vi)(A) In order to protect Federal Earth Exploration-Satellite Service (passive), aeronautical and maritime endpoints in motion operating in the 70 and 80 GHz bands must comply with the following limits:

(*1*) Ground-to-air transmissions shall not exceed an unwanted emission level of -38.5 dBW per

100 MHz in any portion of the 86–92 GHz passive band;

(*2*) Air-to-air, ship-to-shore, and aerostat-to-shore transmissions shall not exceed an unwanted emission level of -29.7 dBW per 100 MHz in any portion of the 86–92 GHz passive band.

(B) Any changes to system specifications, operations, or deployment scenarios for aeronautical or maritime end points in motion shall be pre-coordinated with NTIA and affected Federal agencies, and licensees of aeronautical or maritime end points in motion must cooperate fully with any updates to the required unwanted emission limits that may result from these modifications.

* * * * *

7. Effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, § 101.113 is amended in the table in paragraph (a) by revising entries for "71,000 to 76,000" and "81,000 to 86,000" to read as follows:

**§ 101.113 Transmitter power limitations.**

(a) * * *

| Frequency band (MHz) | Maximum allowable EIRP[1 2] | |
|---|---|---|
| | Fixed[1 2] (dBW) | Mobile (dBW) |
| * * * | * * | * * |
| 71,000 – 76,000[13,14] | + 55 | + 55 |
| 81,000 – 86,000[13,14] | + 55 | + 55 |
| * * * | * * | * * |

[1]Per polarization.

[2]For multiple address operations, see § 101.147. Remote alarm units that are part of a multiple address central station projection system are authorized a maximum of 2 watts.

* * * * *

[13]The maximum transmitter power is limited to 3 watts (5 dBW) unless a proportional reduction in maximum authorized EIRP is required under § 101.115. The maximum transmitter power spectral density is limited to 150 mW per 100 MHz.

[14]The EIRP limit for fixed and mobile stations used for aeronautical and maritime endpoints in motion is 57 dBW.

* * * * *

8. Effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, § 101.115 is amended in the table in paragraph (b)(2) by revising the entries for "71,000 to 76,000 (co-polar)", "71,000 to 76,000 (cross-polar)", "81,000 to 86,000 (co-polar)", and "81,000 to 86,000 (cross-polar)" to read as follows:

**§ 101.115 Directional antennas.**

* * * * *

(b) * * *

(2) * * *

**ANTENNA STANDARDS**

| Frequency (MHz) | Category | Maximum beamwidth to 3 dB points[1] (included angle in degrees) | Minimum antenna gain (dBi) | Minimum radiation suppression to angle in degrees from centerline of main beam in decibels | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 5° to 10° | 10° to 15° | 15° to 20° | 20° to 30° | 30° to 100° | 100° to 140° | 140° to 180° |
| * * * * * * * | | | | | | | | | | |
| 71,000 to 76,000 (co-polar)[14] | N/A | 2.2 | 38 | 22 | 28 | 32 | 35 | 37 | 55 | 55 |
| 71,000 to 76,000 (cross-polar)[14] | N/A | 2.2 | 38 | 35 | 35 | 40 | 42 | 47 | 55 | 55 |
| 81,000 to 86,000 (co-polar)[14] | N/A | 2.2 | 38 | 22 | 28 | 32 | 35 | 37 | 55 | 55 |
| 81,000 to 86,000 (cross-polar)[14] | N/A | 2.2 | 38 | 35 | 35 | 40 | 42 | 47 | 55 | 55 |
| * * * * * * * | | | | | | | | | | |

[1] If a licensee chooses to show compliance using maximum beamwidth to 3 dB points, the beamwidth limit shall apply in both the azimuth and the elevation planes.
* * * * *

[14]Antenna gain less than 50 dBi (but greater than or equal to 38 dBi) is permitted only with a proportional reduction in maximum authorized EIRP in a ratio of 2 dB of power per 1 dB of gain, so that the maximum allowable EIRP (in dBW) for antennas of less than 50 dBi gain becomes + 55-2(50-G), where G is the antenna gain in dBi. In addition, antennas in these bands must meet the following additional standard for minimum radiation suppression: At angles of less than 5 degrees from the centerline of main beam, cross-polar discrimination must be at least 21 dB.

* * * * *

9. Effective September 1, 2024, § 101.147 is amended by adding paragraph (z)(3) to read as follows:

**§ 101.147 Frequency assignments.**

* * * * *

(z) * * *

(3) The following channel plans apply to the 71,000–76,000 MHz and 81,000–86,000 MHz bands:

(i) *250 MHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 71250 | 81250 |
| 71500 | 81500 |
| 71750 | 81750 |
| 72000 | 82000 |
| 72250 | 82250 |
| 72500 | 82500 |
| 72750 | 82750 |
| 73000 | 83000 |
| 73250 | 83250 |
| 73500 | 83500 |
| 73750 | 83750 |
| 74000 | 84000 |
| 74250 | 84250 |
| 74500 | 84500 |
| 74750 | 84750 |
| 75000 | 85000 |
| 75250 | 85250 |
| 75500 | 85500 |
| 75750 | 85750 |

(ii) *500 MHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 71375 | 81375 |
| 71875 | 81875 |
| 72375 | 82375 |
| 72875 | 82875 |
| 73375 | 83375 |
| 73875 | 83875 |
| 74375 | 84375 |
| 74875 | 84875 |
| 75375 | 85375 |

(iii) *750 MHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 71500 | 81500 |
| 72250 | 82250 |
| 73000 | 83000 |
| 73750 | 83750 |
| 74500 | 84500 |
| 75250 | 85250 |

(iv) *1 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 71625 | 81625 |
| 72625 | 82625 |
| 74125 | 84125 |
| 75125 | 85125 |

(v) *1.25 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 71750 | 81750 |
| 73000 | 83000 |
| 74250 | 84250 |

(vi) *1.5 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 71875 | 81875 |
| 74375 | 84375 |

(vii) *1.75 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 72000 | 82000 |
| 74500 | 84500 |

(viii) *2.0 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 72125 | 82125 |
| 74625 | 84625 |

(ix) *2.25 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 72250 | 82250 |
| 74750 | 84750 |

(x) *2.5 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 72375 | 82375 |

(xi) *2.75 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 72500 | 82500 |

(xii) *3 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 72625 | 82625 |

(xiii) *3.25 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 72750 | 82750 |

(xiv) *3.5 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 72875 | 82875 |

(xv) *3.75 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 73000 | 83000 |

(xvi) *4 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 73125 | 83125 |

(xvii) *4.25 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 73250 | 83250 |

(xviii) *4.5 GHz authorized bandwidth*.

| Transmit (receive) (MHz) | Receive (transmit) (MHz) |
|---|---|
| 73375 | 83375 |

10. Effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, § 101.1501 is revised to read as follows:

**§ 101.1501 Service areas.**

The 70/80/90 GHz bands are licensed on the basis of non-exclusive nationwide licenses. There is no limit to the number of non-exclusive nationwide licenses that may be granted for these bands, and these licenses will serve as a prerequisite for registering individual point-to-point links. In the 71–76 GHz and 81–86 GHz bands, nationwide non-exclusive licenses also serve as a blanket license for air-to-air and ship-to-ship operations, and as a prerequisite to register ground-to-air (GTA) stations and to operate associated GTA and air-to-ground (ATG) transmissions; and as a prerequisite to register shore stations and aerostat relay stations and to operate associated ship-to-shore, shore-to-ship, shore-to-aerostat, aerostat-to-ship, and aerostat-to-shore transmissions.

11. Effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, § 101.1507 is revised to read as follows:

**§ 101.1507 Permissible operations.**

Licensees may use the 70 GHz, 80 GHz, and 90 GHz bands for any point-to-point, non-broadcast service**.** Licensees may use the 70 GHz and 80 GHz bands for aeronautical and maritime service as set forth in § 101.1528. The segments may be unpaired or paired, but pairing will be permitted only in a standardized manner (*e.g.,* 71–72.25 GHz may be paired only with 81–82.25 GHz, and so on). The segments may be aggregated without limit.

12. Delayed indefinitely, § 101.1523 is amended by revising paragraph (a) and adding paragraph

(e) to read as follows:

**§ 101.1523 Sharing and coordination among non-government licensees and between non-government and government services.**

(a) Each individual point-to-point link must be registered in a third-party database. Registration of aeronautical ground stations, maritime shore stations, and aerostats for operation of aeronautical or maritime links to end points in motion in the 71–76 GHz and 81–86 GHz bands will be in a third-party database after the Wireless Telecommunications Bureau announces by public notice the details of the implementation of a third-party database for such links to endpoints in motion.

* * * * *

(e) A licensee must successfully complete the requirements of this section prior to modifying the technical parameters of a registered link. Except for de minimis modifications, any change to the technical data on a link registration will result in a new interference protection date. A modification to link registration in the 71–76 GHz and 81–86 GHz bands is de minimis, and the registration will retain its existing interference protection date and not lose its existing first-in-time rights, if the modification meets all of the following criteria:

(1) The licensee certifies that the modification is necessary to repair or replace equipment specified in the registration that was constructed and operating under the registration, and;

(2) The modification does not increase the EIRP of a digital system or change the EIRP of an analog system;

(3) The modification does not increase the channel bandwidth;

(4) The modification does not change the power density;

(5) The modification does not increase the receiver sensitivity;

(6) The modification does not increase the antenna beamwidth;

(7) The modification does not increase the antenna gain, except where there is a corresponding reduction transmitter power so that there is no increase in EIRP;

(8) The modification does not involve a change to antenna with less off-axis attenuation at any angle; and

(9) The modification does not change any other technical parameters not mentioned in paragraphs

(e)(1) through (e)(8) of this section.

13. Effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, § 101.1528 is added to subpart Q to read as follows:

**§ 101.1528 Requirements for aeronautical and maritime links to, from, or between endpoints in motion.**

(a) *Requirements for aeronautical ground stations and endpoints in motion*. (1) Air-to-ground transmissions are permitted only in the 71–76 GHz band.

(2) Ground-to-air transmissions are permitted only in the 81–86 GHz band.

(3) Air-to-air transmissions are permitted only between aircraft that are separated by a minimum slant path distance of 50 km.

(4) Transmissions are only permitted to and from aircraft at altitudes between 10,000 ft and 50,000 ft.

(5) Ground stations must operate with a minimum elevation angle of 5 degrees and a maximum elevation angle of 45 degrees.

(6) Ground stations must be located at least 10 km from any existing Non-Federal FSS earth station or Federal facility listed in table 4 to paragraph (c)(2) of this section, absent a coordination agreement with the FSS operator.

(7) Ground stations must be located at least 150 km from the specific Federal facilities and not within the areas listed in table 3 to paragraph (c)(1) of this section, absent a coordination agreement with the Federal operator.

(8) Ground stations must be located at least 10 km from any existing Federal or non-Federal fixed station receiver, absent a coordination agreement with the fixed station operator.

(9) Air-to-air transmissions are permitted in 81–86 GHz subject to the following limitations;

(i) EIRP signal levels radiated along a line between the airborne transmitter and the latitude and longitude of the observatories in table 3 to paragraph (c)(1) of this section, which must be maintained as the airborne transmitter moves, cannot exceed the levels shown in table 1 to this paragraph (a)(9)(i). Within the range of 150 km and 375 km, the maximum allowable EIRP levels for horizontal distances not listed in table below may be approximated by linear interpolation.

**Table 1 to Paragraph (a)(9)(i) - List of Maximum Allowable EIRP levels, in dBW**

| Frequency (GHz) | Horizontal Distance (km) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 150 | 175 | 200 | 225 | 250 | 275 | 300 | 325 | 350 | 375 |
| 81 | -11.2 | -8.8 | -6.5 | -4.2 | -1.5 | 1.1 | 3.9 | 6.7 | 10 | 13.5 |
| 82 | -11.5 | -9.2 | -6.9 | -4.6 | -2 | 0.5 | 3.2 | 6 | 9.2 | 12.6 |
| 83 | -11.7 | -9.5 | -7.3 | -5 | -2.4 | 0 | 2.7 | 5.4 | 8.6 | 11.9 |
| 84 | -11.9 | -9.7 | -7.5 | -5.3 | -2.8 | -0.4 | 2.3 | 4.9 | 8 | 11.3 |
| 85 | -12.1 | -9.9 | -7.8 | -5.5 | -3 | -0.7 | 1.9 | 4.5 | 7.6 | 10.8 |
| 86 | -12.2 | -10 | -7.9 | -5.7 | -3.3 | -0.9 | 1.7 | 4.2 | 7.3 | 10.5 |

(ii) A licensee of aeronautical end points in motion must have a capability to target specific areas which can be added to a "block list" as part of a dynamic link management system. If air-to-air transmission within the main beam of the radio astronomy receiver cannot be avoided, air-to-air transmissions within the radio horizon of the radio astronomy site (as specified in table 2 to this paragraph (a)(9)(ii)) should not occur.

**Table 2 to Paragraph (a)(9)(ii) - Approximate Radio Horizon, in Horizontal Distance (km)**

| Altitude (m) | Approximate Radio Horizon (km) (horizontal distance) |
|---|---|
| 10,360 | 375 |
| 8,000 | 315 |
| 6,000 | 260 |
| 5,000 | 220 |
| 4,000 | 180 |
| 3,000 | 125 |

(iii) The list of radio astronomy sites may be periodically updated by the NTIA and the FCC. This rule may be superseded by a coordination agreement between the licensee and NSF, in which case the coordination agreement will specify the technical restrictions.

(10) Air-to-air transmissions in the 71–76 GHz band are subject to the following restrictions:

(i) EIRP signal levels shall be limited to 20 dBW/1000 MHz towards each military installation listed in table 4 to paragraph (c)(2) that is within 375 km of the airborne transmitter. This 20 dBW/1000 MHz EIRP applies to the power radiated along a line between the airborne transmitter and the latitude and longitude of the military installations in table 4 to paragraph (c)(2) of this section and must be maintained as the airborne transmitter moves. An EIRP of 57 dBW/1000 MHz is allowed in other directions. The list of military installations in table 4 to paragraph (c)(2)of this section may be periodically updated by the

NTIA and the FCC. This rule may be superseded by a coordination agreement between the licensee and the Department of Defense (DoD), in which case the coordination agreement will specify the technical restrictions and allow the licensee and DoD to update the list of protected installations in the agreement. The locations of all aeronautical end-point-in-motion ground stations will be provided to NTIA and DoD as part of the coordination process.

(ii) A licensee of aeronautical end points in motion must have a capability to target specific areas which can be added to a "block list" as part of a dynamic link management system. If air-to-air transmission within the main beam of the radio astronomy receivers associated with the observatories in table 3 to paragraph (c)(1) of this section cannot be avoided, air-to-air transmissions within the radio horizon of the radio astronomy site (as specified in table 2 to paragraph (a)(9)(ii) of this section) should not occur.

(iii) The list of radio astronomy sites may be periodically updated by the NTIA and the FCC. This rule may be superseded by a coordination agreement between the licensee and NSF, in which case the coordination agreement will specify the technical restrictions.

(b) *Requirements for maritime shore stations, aerostats, and endpoints in motion*. (1) Ship-to-shore transmissions are only permitted in the 81–86 GHz band.

(2) Shore-to-ship transmissions are only permitted in the 71–76 GHz band.

(3) Shore-to-aerostat transmissions are only permitted in the 71–76 GHz band.

(4) Aerostat-to-ship transmissions are only permitted in the 71–76GHz band.

(5) Aerostat-to-shore transmissions are only permitted in the 81–86GHz band.

(6) Aerostat must not operate above an altitude limit of 1000 ft.

(7) Ship-to-ship communications are limited to ships located more than 30 km offshore, or closer only where the main beam of the transmit antenna is oriented at least 15 degrees away from any point on the shore.

(8) Ship stations and aerostat stations must only operate when there is a minimum separation of 150 km to the specific Federal facilities and not within the areas listed in table 3 to paragraph (c)(1) of this section, absent a coordination agreement with the Federal operator.

(9) Shore-to-ship and ship-to-shore transmission must only occur between stations that are

located at least 10 km from the Federal military installations listed in table 4 to paragraph (c)(2) of this section, absent a coordination agreement with the Federal operator.

(c) *Protected Federal sites*. (1) RAS and VLBA sites:

**Table 3 to Paragraph (c)(1)**

| RAS Station Name | North Latitude | West Longitude |
|---|---|---|
| Arizona Radio Observatory (ARO) 12-meter | 31° 57' 11.9" | 111° 36' 53.6" |
| Green Bank Observatory | 38° 25' 59" | 79° 50' 23" |
| Very Large Array (VLA), Socorro, NM | 34° 04' 44" | 107° 37' 06" |
| Owens Valley Radio Observatory (OVRO), Big Pine, CA | 37° 14′ 02″ | 118° 16′ 55″ |
| Haystack Observatory, Westford, MA | 42° 37' 24" | 071° 29' 18" |
| National Radio Astronomy Observatory, Very Long Baseline Array Stations | | |
| Brewster, WA | 48° 07' 52" | 119° 41' 00" |
| Fort Davis, TX | 30° 38' 06" | 103° 56' 41" |
| Hancock, NH | 42° 56' 01" | 71° 59' 12" |
| Kitt Peak, AZ | 31° 57' 23" | 111° 36' 45" |
| Los Alamos, NM | 35° 46' 30" | 106° 14' 44" |
| Mauna Kea, HI | 19° 48' 05" | 155° 27' 20" |
| North Liberty, IA | 41° 46' 17" | 91° 34' 27" |
| Owens Valley, CA | 37° 13' 54" | 118° 16' 37" |
| Pie Town, NM | 34° 18' 04" | 108° 07' 09" |
| Saint Croix, VI | 17° 45' 24" | 64° 35' 01" |
| National Radio Quiet Zone | Rectangular area between latitudes 37°30'N and 39°15'N, and longitudes 78°30'W and 80°30'W. | |
| Next-generation Very Large Array (ngVLA) | Rectangular area between latitudes 31°22'1.9"N and 34°23'10"N, and longitudes 109°1'53.4"W and 103°4'39"W | |

(2) Military installations:

**Table 4 to Paragraph (c)(2)**

| Military Installation | Latitude | Longitude |
|---|---|---|
| Redstone Arsenal, AL…… | 34° 41' 42" N | 086° 39' 04" W |
| Fort Huachuca, AZ……. | 31° 33 '18" N | 110° 20' 59" W |
| Yuma Proving Ground, AZ…… | 33° 01' 02" N | 114° 15' 05" W |
| Beale AFB, CA……... | 39° 06' 41" N | 121° 21' 36" W |
| Camp Parks Reserve Forces Training Area, CA…… | 34° 43' 00" N | 121° 54' 08" W |
| China Lake Naval Air Weapons Station, CA……. | 35° 41' 05" N | 117° 41' 19" W |
| Edwards AFB, CA…….. | 34° 54′ 58″ N | 117° 56′ 07″ W |
| Fort Irwin, CA…… | 35° 16' 22" N | 116° 41' 05" W |
| Marine Corps Air Ground Combat Center, CA…….. | 34° 13' 54" N | 116° 03' 42"W |
| Buckley AFB, CO……... | 39° 42' 36" N | 104° 45' 29"W |
| Schriever AFB, CO……. | 38° 48' 12" N | 104° 31' 32" W |
| Fort Gordon, GA…… | 33° 25' 14" N | 082° 09' 09" W |
| Naval Satellite Operations Center, GU……... | 13° 34' 55" N | 144° 50' 50" E |
| Naval Computer and Telecomm Area Master Station, Pacific, HI… | 21° 31' 16" N | 157° 59' 57" W |

| | | |
|---|---|---|
| Fort Detrick, MD…… | 39° 26' 08" N | 077° 25' 38" W |
| Nellis AFB, NV…….. | 36° 14' 29" N | 115° 03' 03" W |
| Nevada Test Site, NV……. | 38° 33' 41" N | 116° 42' 30" W |
| Tonapah Test Range Airfield, NV…….. | 37° 47' 56" N | 116° 46' 51" W |
| Cannon AFB, NM……... | 34° 23' 23" N | 103° 19' 06" W |
| White Sands Missile Range, NM…… | 32° 56' 38" N | 106° 25 '11" W |
| Dyess AFB, TX……... | 31° 10' 10" N | 099° 41' 01" W |
| Fort Bliss, TX……. | 31° 48' 45" N | 106° 25' 17" W |
| Fort Sam Houston, TX…… | 29° 26' 34" N | 098° 26' 33" W |
| Goodfellow AFB, TX……. | 31° 26' 05" N | 100° 24' 11" W |
| Kelly AFB, TX……... | 29° 22' 51" N | 098° 34' 40" W |
| Utah Test and Training Range, UT…… | 40° 12' 00" N | 112° 54' 00" W |
| Fort Belvoir, VA……. | 38° 43' 08" N | 077° 09' 15" W |
| Naval Satellite Operations Center, VA……... | 36° 34' 00" N | 076° 14' 00" W |

14. Delayed indefinitely, § 101.1528 is amended by adding paragraphs (a)(11), (b)(10), and (d) to read as follows:

**§ 101.1528 Requirements for aeronautical and maritime links to, from, or between endpoints in motion.**

(a) * * *

(11) Aeronautical operators must coordinate with Federal operators and register ground-to-air stations, and must not operate such facilities or any associated air-to-ground transmissions until registration has successfully been completed.

(b) * * *

10) Maritime operators must coordinate with Federal operators and register shore and aerostat transmitters, and must not operate such facilities or any associated ship-to-shore transmissions until registration has successfully been completed.

* * * * *

(d) *Review of certain proposed technologies in the 71–76 and 81–86 GHz bands.* Prior to registration of any aeronautical or maritime links—to, from, or between endpoints in motion—each licensee must demonstrate, in accordance with the process to be established by the Wireless Telecommunications Bureau and Office of Engineering and Technology, *see* 47 CFR 0.241(l), 0.331(g) of this title, that its technologies for point-to-endpoint-in-motion communications to aircraft and ships are capable of meeting specific technical and operating requirements set forth in this section.

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