Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
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Modifying Emissions Limits for the 24.25-24.45 GHz and 24.75-25.25 GHz Bands	)	ET Docket No. 21-186
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REPORT AND ORDER

Adopted: November 27, 2024 **Released: December 2, 2024**

By the Commission:

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Heading Paragraph #

I. INTRODUCTION

1. In this Report and Order, we revise the Commission's rules for the 24.25-24.45 GHz and 24.75-25.25 GHz bands (collectively, the 24 GHz band) to implement certain decisions made in the World Radiocommunication Conference held by the International Telecommunication Union (ITU) in 2019 (WRC-19). Specifically, we align part 30 of the Commission's rules for mobile operations in these frequencies with the Resolution 750 limits adopted at WRC-19 to protect the passive 23.6-24.0 GHz band from unwanted emissions on the timeframes adopted at WRC-19.

II. BACKGROUND

2. The 23.6-24.0 GHz band is allocated to several passive scientific and research services, including the Earth Exploration Satellite Service (EESS) (passive), on a primary basis.[1] EESS utilizes passive sensors located on satellites to measure the power level of naturally occurring radio emissions from water vapor and cloud liquid water molecules in the atmosphere, which are critical measurements for climatology and weather forecasting.[2] Because naturally occurring radio emissions in the 23.6-24.0 GHz band are very weak, the passive sensors that measure them are sensitive and vulnerable to interference.[3]

3. Observations made by EESS sensors operating in the 23.6-24.0 GHz band are essential for meteorological applications.[4] The National Oceanic and Atmospheric Administration (NOAA) uses EESS to take measurements considered vital to the accuracy and timeliness of weather forecasting, including hurricane and tornado warnings, and the National Aeronautics and Space Administration (NASA) also operates passive EESS systems in the band to conduct climatological science.[5] Additionally, EESS passive sensors aid EESS active instruments that use radar on satellites to measure ocean topography, sea ice, and precipitation by measuring total atmospheric water vapor and correcting the "refraction-induced path delay in the radar signal."[6] The 23.6-24.0 GHz band has been used for passive sensor observations for a considerable length of time and has generated valuable long-term climate data records.[7]

4. The Commission first authorized service in the 24.25-24.45 GHz and 25.05-25.25 GHz bands in 1997, when it transitioned the Digital Electronic Messaging Service (DEMS) to these bands from the 18 GHz band.[8] In 2000, the Commission adopted competitive bidding and service rules for

[1] *See* 47 CFR § 2.106(a). Space Research Service (passive) and Radio Astronomy Service (RAS) also have primary allocations in the 23.6-24.0 GHz band. *Id.*; *see also* CORF Comments at 6 n.18.

[2] ITU Radiocommunication Bureau, Handbook on Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction 75, 78 (2017 ed.), https://library.wmo.int/doc_num.php?explnum_id=3793; *see also* NTIA Comments at 2 (stating that observed moisture data collected by passive sensing in the 23.8 GHz spectrum range serves as the basis for water vapor imagery that is vital to ensure accuracy and timeliness of hourly weather forecasts and severe weather warnings); CORF Comments at 4-5 (describing how observations in the 23.6-24 GHz band are critical to accurately measuring atmospheric humidity over oceans and water vapor in the lowest one kilometer in the atmosphere, which are important inputs to developing accurate weather forecasts). CORF notes that accurate weather forecasting is critical for safety of life and can reduce the costs of natural disasters. CORF Comments at 5.

[3] NTIA Comments at 1-2; *see also* CORF Comments at 6-8 (describing specifics of how interference in the 23.6–24 GHz band affects the overall observing system).

[4] *See* CORF Comments at 3.

[5] NTIA Comments at 1; *see also* NOAA Comments at 2-3; CORF Comments at Table 1.

[6] CORF Comments at 3-4.

[7] *See* CORF Comments at 4; *see also* NOAA comments at 5 (stating that international sharing agreements allow NOAA to share and receive satellite observation information regarding weather forecasting from partner nations).

[8] *See Amendment of the Commission's Rules to Relocate the Digital Electronic Message Service from the 18 GHz Band to the 24 GHz Band and To Allocate the 24 GHz Band for Fixed Services*, ET Docket No. 97-99, Order, 12 FCC Rcd 3471 (1997) (reallocating DEMS from the 18 GHz band to the 24 GHz Band), *reconsideration denied*, Memorandum Opinion and Order, 13 FCC Rcd 15147 (1998); *see also Amendment of the Commission's Rules to Relocate the Digital Electronic Message Service from the 18 GHz Band to the 24 GHz Band and To Allocate the 24 GHz Band for Fixed Services*, ET Docket No. 97-99, Order, 12 FCC Rcd 8266 (WTB PSPWD 1997) (modifying DEMS-based licenses to change authorized band of operations from 18 GHz to 24 GHz).

24.25-24.45 GHz and 25.05-25.25 GHz bands and created a 24 GHz Service.[9] This 24 GHz Service had a total of 176 Economic Areas (EAs) or EA-like service areas.[10] In 2004, the Commission held Auction 56, in which it made 880 24 GHz Service licenses available. Only seven of the 880 24 GHz Service licenses were sold.[11] As of 2017, there were 33 active DEMS licenses in these bands.[12] While the former DEMS licenses were converted to Upper Microwave Flexible Use Services (UMFUS) licenses, they were subsequently cancelled.[13]

5. In 2016, the Commission adopted licensing and technical rules for UMFUS services in the 27.5-28.35 GHz band, the 37.6-38.6 GHz band, and the 38.6-40 GHz band.[14] Expanding on the 2016 efforts to open high-frequency spectrum, in 2017, the Commission authorized the 24 GHz band for UMFUS, and generally applied the same licensing and technical rules to UMFUS in the 24 GHz band that it applied to UMFUS in other upper microwave bands.[15] The UMFUS rules allow licensees flexibility to the services they will deploy and the architecture of their networks. Under these rules, licensees are able to deploy mobile services,[16] but they also may deploy fixed point-to-point and point-to-multipoint systems.[17] Among other things, the UMFUS rules specify that emissions outside of a licensee's assigned frequency block must be limited to –13 dBm/MHz.[18] In its decision authorizing UMFUS in the 24 GHz band, the Commission noted ongoing ITU studies to establish emissions limits applicable to International

[9] *See Amendments to Parts 1, 2, 87 and 101 of the Commission's Rules to License Fixed Services at 24 GHz*, WT Docket No. 99-327, Report and Order, 15 FCC Rcd 16934, 16937, para. 3 (2000) (adopting competitive bidding and service rules for 24 GHz Band). We note as a point of clarification that the 24 GHz Service and the UMFUS 24 GHz band encompass different, but overlapping frequencies. The frequencies 24.25-24.45 GHz and 25.05-25.25 GHz refer to the 24 GHz Service, whereas we refer to the 24.25-24.45 GHz and 24.75-25.25 GHz bands collectively as the 24 GHz band.

[10] *See* 47 CFR § 101.523 (2016).

[11] *See 24 GHz Service Spectrum Auction Closes, Winning Bidders Announced*, Public Notice, 19 FCC Rcd 14738 (WTB 2004).

[12] *See Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al.*, GN Docket No. 14-177, IB Docket Nos. 15-256 and 97-95, WT Docket No. 10-112, Second Report and Order, Second Further Notice of Proposed Rulemaking, Order on Reconsideration, and Memorandum Opinion and Order, 32 FCC Rcd 10988, 10995, para. 16 (2017) (*Spectrum Frontiers 2nd R&O*).

[13] *See FiberTower Spectrum Holdings, LLC*, Order on Remand and Memorandum Opinion and Order, 33 FCC Rcd 253 (2018).

[14] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al*., GN Docket No. 14-177, IB Docket Nos. 15-256 and 97-95, RM-11664, WT Docket No. 10-112, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8023-63, paras. 17-124 (2016).

[15] *See Spectrum Frontiers 2nd R&O*, 32 FCC Rcd at 10994-11002, paras. 15-42.

[16] *See* 47 CFR §§ 30.6(a), 30.202(a).

[17] *See* 47 CFR pt. 30 Subpart E.

[18] *See* 47 CFR § 30.203(a). In the bands immediately outside and adjacent to the licensee's frequency block, having a bandwidth equal to 10 percent of the channel bandwidth, the conductive power or the total radiated power of any emission shall be −5 dBm/MHz or lower. *Id*. As the 23.6-24 GHz passive band is 250 megahertz away from the UMFUS bands, the −5 dBm/MHz does not apply within that passive band for UMFUS licensees.

Mobile Telecommunications (IMT)[19] to protect passive sensors in the 23.6 – 24.0 GHz band, and it acknowledged that the UMFUS rules might be revisited once the ITU studies had been completed.[20]

6. WRC-19 allocated 24.25-25.25 GHz to mobile (except aeronautical) on a primary basis in Regions 1 and 2, globally identified the 24.25-27.5 GHz band for IMT, and established unwanted emissions limits applicable to IMT in the 24.25-27.5 GHz band to protect passive systems in the 23.6-24.0 GHz band.[21] To implement these limits, WRC-19 modified a footnote to the International Table of Allocations to add Resolution 750 (Rev. WRC-19).[22] Resolution 750 specifies unwanted emissions limits in terms of Total Radiated Power (TRP)[23] as the amount of power that may be radiated into any 200 megahertz block of the 23.6-24.0 GHz passive band by IMT base stations and IMT mobile stations operating in the 24.25-27.5 GHz band. Resolution 750 sets emissions limits for current IMT devices as well as more stringent emissions limits for IMT devices that will be brought into use in the 24.25-27.5 GHz band after September 1, 2027.[24] These two sets of unwanted emissions limits are shown in Table 1.

Table 1: WRC-19 Resolution 750 Unwanted emissions permitted within any 200 megahertz in the 23.6-24 GHz passive band

Type of Station	Current TRP Limits	TRP Limits After Sept. 1, 2027
IMT Base Stations	–33 dBW	–39 dBW
IMT Mobile Stations	–29 dBW	–35 dBW

7. On April 26, 2021, the Office of Engineering and Technology (OET) and the Wireless Telecommunications Bureau (WTB) issued a *Public Notice* to develop a record on whether and how the Commission could implement the emissions limits contained in Resolution 750 for the active services in the 24 GHz band.[25] The *Public Notice* sought comment on amending part 30 of the Commission's rules to conform to the unwanted emissions limits into the passive 23.6-24.0 GHz band that were adopted at

[19] IMT is the generic term used by the ITU to designate broadband mobile systems and encompasses IMT-2000, IMT- Advanced, and IMT-2020. *See* ITU, *Radiocommunication Sector ITU-R FAQ on International Telecommunications* (Feb. 23, 2022), https://www.itu.int/en/ITU-R/Documents/ITU-R-FAQ-IMT.pdf. As described below, the Commission rules do not define IMT. *See infra* para. 11.

[20] *See Spectrum Frontiers 2nd R&O*, 32 FCC Rcd at 10997, para. 22; *see also Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al.*, GN Docket No. 14-177, WT Docket No. 10-112, Third Report and Order, Memorandum Opinion and Order, and Third Further Notice of Proposed Rulemaking, 33 FCC Rcd 5576, 5581-82, para. 15 (2018) (recognizing the need to protect passive satellite operations that provide important data necessary for weather predictions and warnings, and stating that "[o]nce interference protection standards are agreed upon internationally we will, if necessary, consider through notice and comment whether any modification of our current out-of-band limits may be needed").

[21] *See* ITU Radio Regulations (2020), Resolution 750 (Rev.WRC-19), Table 1, Vol. 3 at 519, 522, https://www.itu.int/en/myitu/Publications/2020/09/02/14/23/Radio-Regulations-2020. Resolution 750 specifies limits of unwanted emission power for IMT base stations and mobile stations.

[22] *See* ITU Radio Regulations (2020), n.5.338A, Vol. 1 at 100.

[23] *See* ITU Radio Regulations (2020), Resolution 750 (Rev.WRC-19), Note 5, Vol. 3 at 522.

[24] *See* ITU Radio Regulations (2020), Resolution 750 (Rev.WRC-19), Table 1, Vol. 3 at 522. For IMT base stations and mobile stations brought into use prior to September 1, 2027, the more relaxed unwanted emissions limits will continue to apply.

[25] *See Office of Engineering & Technology and the Wireless Telecommunications Bureau Seek Comment on Emission Limits for the 24.25-27.5 GHz Band*, ET Docket No. 21-186, GN Docket No. 14-177, Public Notice, 36 FCC Rcd 7561 (OET/WTB 2021) (*Public Notice*).

WRC-19 and/or adding footnotes to the United States Table of Frequency Allocations at part 2 of the Commission's rules.[26] Twelve parties made filings in response to the *Public Notice*.[27]

8. On December 22, 2023, the Commission released a *Notice of Proposed Rulemaking* (*Notice*) proposing to implement certain decisions regarding the 24.25-27.5 GHz band made at WRC-19.[28] The *Notice* proposed to align part 30 of the Commission's rules for mobile operations in the 24 GHz band with the Resolution 750 limits on unwanted emissions into the passive 23.6-24.0 GHz band. In addition, the *Notice* also sought comment on several different issues, including: (1) applying Resolution 750 limits to mobile operations; (2) applying emissions limits more stringent than Resolution 750; (3) applying Resolution 750 limits to fixed operations; (4) exempting indoor small-cell operations from Resolution 750 limits; (5) allowing conductive power measurements; and (6) the schedule for transition to the new Resolution 750 limits applicable after September 1, 2027.[29]

9. Comments on the *Notice* were due February 28, 2024, and reply comments were due March 14, 2024.[30] The Commission received ten comments and four reply comments. A list of commenters, reply commenters, and *ex parte* filers is contained in Appendix C.

III. DISCUSSION

A. Revision of Commission Rules to Adopt Resolution 750 Unwanted Emissions Limits

10. Consistent with the proposal in the *Notice*,[31] we adopt the Resolution 750 unwanted out-of-band emissions (OOBE) limits and apply these limits to all mobile operations in the 24 GHz band. In response to the *Notice*, all commenters, including the weather community, scientific community, mobile operators, equipment manufacturers, federal agencies, and other commenters, agree the Commission should align its rules for mobile operations in the 24 GHz band with Resolution 750.[32] We find that the Resolution 750 OOBE limits will appropriately protect sensitive passive sensing operations in the 23.6-24.0 GHz band, while at the same time allowing next generation wireless service to continue to develop

[26] *Public Notice*, 36 FCC Rcd at 7563 (citing 47 CFR § 2.106; 47 CFR pt. 30).

[27] Parties responding to the *Public Notice* included American Geophysical Union, American Meteorological Society, and National Weather Association; AT&T; The National Academy of Sciences Committee on Radio Frequencies (CORF); CTIA; Elliot Eichen, Ph.D. Principal, Choyu Networks; Ericsson; IEEE Geoscience and Remote Sensing Society (IEEE GRSS); Mike Marcus and Josep Jornet; Nokia; National Telecommunications and Information Administration (NTIA); Qualcomm Incorporated; and T-Mobile USA, Inc.

[28] *Modifying Emission Limits for the 24.25-24.45 GHz and 24.75-25.25 GHz Bands*, ET Docket No. 21-186, Notice of Proposed Rulemaking, FCC 23-114, 2023 WL 8946049 (rel. Dec. 22, 2023) (*Notice*).

[29] *See generally Notice*. The *Notice* (at para. 29) also sought comment on a proposal to use a Real-time Geospatial Spectrum Sharing (RGSS) system as an alternative means of protecting EESS. WIRG touts its work developing a proof of concept RGSS system and asks that the Commission establish rules allowing use of RGSS. WIRG Comments at 4-5, *Ex Parte* Presentation of WIRG (filed Mar. 20, 2024). While we believe adopting a rule authorizing the use of RGSS is premature at this time, we encourage further research and study of such systems and are open to consideration of such a system as it becomes more developed.

[30] *Modifying Emission Limits for the 24.25-24.45 GHz and 24.75-25.25 GHz Bands*, 89 Fed. Reg. 5440 (Jan. 29, 2024).

[31] *See Notice* at para. 8. Our action today is consistent with the Commission's statements prior to the 24 GHz auction that it could revisit the OOBE limits applicable to the 24 GHz band once international studies were complete. *See* para. 5, *supra*.

[32] *See* The American Geophysical Union, American Meteorological Society and National Weather Association (AGU/AMS/NWA) Comments at 12; IEEE GRSS Comments at 5; CORF Comments at 8; T-Mobile Comments at 8; CTIA Comments at 7; Ericsson Comments at 1; Qualcomm Inc. Comments at 1; NTIA Comments at 3; NASA Comments at 1; NOAA Comments 3; Michael Ravnitzky Comments at 1; GuRu Wireless Inc. Comments at 2; AT&T Reply Comments at 2; Nokia Reply Comments at 2.

in the United States. In addition, adopting the Resolution 750 limits would promote international harmonization and result in certain public interest benefits associated with such harmonization, including facilitating the provision of advanced wireless services in the U.S., providing regulatory certainty to all interested stakeholders, and promoting spectrum use by both wireless providers and the weather and satellite communities.[33]

11. Consistent with the *Notice*,[34] we also apply Resolution 750 limits to all mobile operations (as defined in parts 2 and 20 of the Commission's rules)[35] in the 24 GHz band. As adopted by WRC-19, the Resolution 750 limits apply only to IMT base and mobile stations. Commenters who addressed the issue support applying the Resolution 750 unwanted OOBE limits to all mobile operations, rather than just IMT operations.[36] Moreover, our rules do not define IMT as a separate category of mobile, nor do they require that equipment comply with a particular standard in the 24 GHz band.[37] Furthermore, no commenter offered a technical basis for distinguishing between IMT and other mobile operations for purposes of domestic spectrum use. Finally, attempting to treat non-IMT mobile operations differently from IMT mobile operations could cause confusion and difficulties with enforcing the limits, as suggested in the *Notice*.[38]

12. As of the effective date of the rules adopted herein, mobile operations in the 24 GHz band will be required to comply with the current limits adopted at WRC-19 (which we refer to as Phase 1 limits).[39] We find that the application of the Resolution 750 OOBE limits to mobile operations strikes the appropriate balance between protecting adjacent passive sensing operations and facilitating use of the 24 GHz band.[40]

13. *Rule Amendments.* In the *Notice*, the Commission proposed to make any changes to the limits on emissions into the 23.6-24.0 GHz band by amending the part 30 rules and adding a footnote to the U.S. Table of Allocations.[41] The Commission noted that, since the part 30 rules already contained a rule governing emissions limits, it appeared to be appropriate to incorporate any changes made in this proceeding into that rule.[42] Commenters broadly agree that these changes are appropriate ways of aligning the Commission's rules with WRC-19 Resolution 750.[43] These limits will be incorporated into

[33] *See Notice* at para. 11.

[34] *Notice* at para. 10.

[35] *See* 47 CFR § 2.1 ("Mobile Service. A radiocommunication service between mobile and land stations, or between mobile stations."); *see also* 47 CFR § 20.3 ("Mobile Service. A radio communication service carried on between mobile stations or receivers and land stations, and by mobile stations communicating among themselves, and includes: (a) Both one-way and two-way radio communications services; (b) A mobile service which provides a regularly interacting group of base, mobile, portable, and associated control and relay stations (whether licensed on an individual, cooperative, or multiple basis) for private one-way or two-way land mobile radio communications by eligible users over designated areas of operation; and (c) Any service for which a license is required in a personal communications service under part 24 of this chapter.")

[36] *See, e.g.*, NOAA Comments at 13; AGU/AMS/NWA Comments at 12; T-Mobile Comments at 8; CTIA Reply Comments at 4.

[37] *See Notice* at para. 16.

[38] *See Notice* at para. 16.

[39] *See Notice* at para. 16. Correspondingly, we refer to the Resolution 750 unwanted emissions limits applicable after September 1, 2027 as the Phase 2 limits.

[40] *See Notice* at para. 11.

[41] *Notice* at para. 15.

[42] *See Notice* at para. 15 & n.50 (citing 47 CFR § 30.203).

[43] *See, e.g.*, NOAA Comments at 2; NTIA Comments at 3; AT&T Comments at 1-3; Ericsson Comments at 1.

our part 30 technical rules as well as codified in a new U.S. footnote to the Table of Frequency Allocations (Allocation Table) in accordance with the proposal.[44] Further, part 2 of the Commission's rules is amended to allow the Table of Frequency Allocations to show that the Resolution 750 unwanted OOBE limits will apply to all mobile systems.

14. We decline to make other changes to the part 30 rules and the Table of Frequency Allocations footnote, as we do not believe they are necessary. For example, NASA suggests including the start dates of the Phase 1 and Phase 2 OOBE limits in the Table of Allocations.[45] The Phase 2 effective date will be incorporated into the part 30 rule and the Allocation Table footnote. Since the Phase 1 limits will be effective immediately upon the effective date of the rules, we believe there is no need to include the Phase 1 effective date. NASA also recommends that the language of the amendment to the part 30 rules be trimmed down to a cross reference to the Table of Allocations.[46] We will retain the substantive emissions limits in section 30.203 of our rules, as it is the better practice to include the specified limits in our technical rules.

B. Adopting Limits More Stringent Than Resolution 750

15. In the *Notice*, the Commission sought comment on whether it was necessary to adopt even stricter OOBE limits to protect EESS systems than those set forth in Resolution 750 by WRC-19.[47] We decline to adopt limits beyond the Resolution 750 limits because the record does not show that such limits are technically necessary. While the proponents of stricter limits express concern that the Resolution 750 limits will be insufficient to protect EESS, their concerns are speculative.[48] Furthermore, no party has submitted specific technical data justifying stricter limits or evaluating the costs and benefits of applying them as directed in the *Notice*.[49]

16. We also note that NTIA did not advocate for implementation of stricter limits, and NTIA, NOAA, and NASA all agree to the adoption of the Resolution 750 limits.[50] While NOAA maintains that stricter limits would better protect Earth Exploration-Satellite Service (EESS) passive sensors, that measurements gathered by sensitive radiometers in the 23.6 – 24.0 and 31.3 – 31.5 GHz bands could be compromised by unwanted by-products from a 5G signal, and that the Resolution 750 limits may not adequately protect passive sensors below 24 GHz, it nevertheless acknowledges that the WRC-19 limits are a compromise and are what most countries are considering.[51]

17. Moreover, while much of the weather and scientific communities would prefer to adopt more stringent unwanted OOBE limits, they too support the adoption of the Resolution 750 limits, at least as a preliminary step.[52] We note that federal agencies and non-federal licensees have deployed nearly

[44] *See Notice* at para. 10.

[45] *See* NASA Comments at 3.

[46] *See id.*

[47] *See Notice* at para. 13.

[48] While WIRG supports adoption of the Resolution 750 limits as a "minimum acceptable requirement," it suggests that further research would be appropriate, after which the Commission should consider adopting stricter limits. WIRG Comments at 2.

[49] *See Notice* at para. 17.

[50] *See, e.g.*, NTIA Comments at 4 (stating that NTIA, NOAA and NASA all support imposition of the more stringent OOBE limits by the WRC-19 designated deadline of September 2027).

[51] NOAA Comments at 7-10.

[52] *See* CORF Comments at 8; AGU/AMS/NWA Comments at 2; IEEE GRSS Comments at 4; *see also* CORF Comments at 9. CORF's statement that these microwave links may cause weak levels of interference is unsupported.

40,000 point-to-point microwave links in the 21.2-23.6 GHz band — immediately below the 23.6-24.0 GHz band — that operate with a less restrictive -13 dBm/MHz or -20 dBW/200 MHz OOBE limit, and yet there is no indication, and no party has submitted a technical showing, that these point-to-point links have caused harmful interference to passive sensors.[53] In contrast to these directly adjacent point-to-point microwave links, there will be at least 225 megahertz separation between UMFUS operations and the 23.6 – 24 GHz passive band. Given that channels in this band are 100 megahertz wide,[54] this amount of separation is significant.

18. We find that adopting stricter emissions limits could significantly limit the ability to use the band for next generation wireless services and other advanced mobile services.[55] Because millimeter wave spectrum has limited propagation, licensees must deploy higher power to ensure sufficient network coverage. Imposing overly restrictive emissions limits could create higher insertion losses due to filtering requirements, and limit the power carriers can use, adversely affecting services available to consumers.[56] Furthermore, adopting emissions limits unique to the United States would be inconsistent with international harmonization.[57]

19. We are not persuaded that the technical information provided by CORF and the IEEE Geoscience and Remote Sensing Society (IEEE GRSS) justifies adopting stricter OOBE limits. CORF advocates for stricter emissions limits, such as those adopted by the European Commission (−42 dBW/200 MHz) or those of the World Meteorological Organization (−55 dBW/dBW/200 MHz).[58] CORF contends that the Resolution 750 Phase 2 limits of -35 dBW/200 MHz for mobile devices equates to 0.4 mW per device, only a factor of 10 below the ITU-R Recommendation RS.2017 threshold for protection of passive sensors in the 23.6 – 24 GHz band.[59] CORF argues that, even assuming somewhat directional beams from 5G mobile devices, it is clear that deployment of thousands of such devices in urban areas will exceed the ITU threshold,[60] but CORF does not clearly explain how it extrapolates the 0.4 mW per

[53] *See* Ericsson Comments at 3.

[54] 47 CFR § 30.4(a).

[55] *Accord* AT&T Comments at 4; CTIA Comments at 6; Ericsson Comments at 2; T-Mobile Comments at 4; Qualcomm Comments at 3; AT&T Reply Comments at 3-4.

[56] CTIA Comments at 6.

[57] *See* CTIA Comments at 6; *see also* T-Mobile Comments at 3; AT&T Reply Comments at 1-2.

[58] CORF Comments at 7.

[59] *See* CORF Comments at 7-8. CORF states that the "AMSR2 instrument on the GCOM-W1 spacecraft (the successor to NASA's AMSR-E instrument launched on the Aqua mission in 2002) measures natural black-body emission signals over a 400 MHz-wide region of the spectrum at 24 GHz with 14 x 14 km pixels. Thermal emission from one such pixel over dry land at 300 K (80°F) in this band totals to only ~26 W across this ~200 km2 pixel. This 26 W is emitted in all directions, and the AMSR2 instrument receives only a fraction of a trillionth of that power. The ITU-R Recommendation RS.2017 interference threshold equates to requiring that there should be no perturbations (e.g., from RFI) greater than 4 mW total emission across this entire pixel. This requirement enables EESS (passive) measurements to be made with an accuracy of 0.05 K brightness temperature (~0.09°F), which is considered sufficient to provide accurate weather forecasts and reliable quantification of potential signatures of climate change (which are of order of one or two degrees per century). The Res. 750 limits of −35 dBW in 200 MHz for mobile devices equates to 0.4 mW per device, only a factor of 10 below the ITU-R Recommendation RS.2017 threshold." *Id.*

[60] CORF Comments at 8. CORF also notes that the ITU Radiocommunication Sector ("ITU-R") Recommendation RS.2017, establishes a limit of −166 dBW in 200 MHz for the 23.6-24.0 GHz band, to be met over 99.99 percent of a 10,000,000 km² area. *Id.* at 6-7. It argues the limits specified in ITU-R Resolution 750 (Rev. WRC-19), when applied to likely IMT implementations, and taking into consideration typical characteristics of orbiting EESS sensors (described in ITU-R Recommendation RS.1861), fail to meet this RS.2017 criterion particularly when considering the aggregate interference from the vast multiplicity of transmitters that are inherent to the nature of

(continued….)

device figure from the Phase 2 standard. IEEE GRSS supports the stricter limits proposed by CORF, because it maintains that the Resolution 750 limits would allow the presence of signals above the interference threshold in the 23.6-24.0 GHz passive band when more 5G base stations are placed within the sensor's coverage area.[61] We find that both CORF's and IEEE GRSS's analyses are based on the assumptions that there will be large but unknown numbers of mobile devices that are not related to specific deployments or use cases.[62] In addition, IEEE GRSS and NOAA cite the European Union's decision to implement the more stringent limit of -39 dBW/200 MHz as of January 1, 2024, as an argument for applying the more stringent limit on an accelerated timeframe in the U.S.[63] We note, however, that the United States is not similarly situated to the European Union. Terrestrial operations in Europe are above 25 GHz and farther away from the passive services in the 23.6 – 24.0 GHz band than U.S. operations. Given the greater frequency separation distance, it is easier for European providers to permit their mobile operators to use higher power and yet meet stricter emissions limits without impairment to the EESS passive service. While we understand the desire of the weather and scientific communities for the greatest protection possible, the record before us does not support adopting limits stricter than the limits agreed to at WRC-19. Accordingly, we decline to adopt more stringent OOBE limits for the U.S. than those adopted in Resolution 750.[64]

C. Applying Resolution 750 Limits to Other Services

20. *Fixed operations.* The *Notice* sought comment on applying the Resolution 750 emissions limits to fixed operations, including point-to-point and point-to-multipoint operations.[65] We decline to do so. As adopted by the ITU, Resolution 750 does not apply to fixed operations; WRC-19 only studied IMT operations under a mobile service allocation. Fixed operation transmissions are significantly more directional than mobile operations – point-to-point operations have tightly focused and stationary beams, and point-to-multipoint base stations direct signals towards user stations.[66] As noted above, there are existing fixed point-to-point operations under part 101 in the spectrum immediately below the passive band that are not subject to stricter emissions limits, and yet there is no indication that these point-to-point links have caused harmful interference to passive sensors.[67] This is in contrast to the at least 225 megahertz of frequency separation between the UMFUS operations starting at 24.25 GHz and the 23.6-24.0 GHz passive band, which should further help alleviate interference concerns.[68] As fixed

(Continued from previous page)
IMT deployments; CORF assumes deployment of thousands of IMT devices in urban areas is likely an underestimate. *See Id.* at 6-8.

[61] *See* IEEE GRSS Comments at 2-4.

[62] *See* CORF Comments at 8; IEEE GRSS Comments at 4, 6.

[63] *See* IEEE GRSS Comments at 6-7; NOAA Comments at 10-11.

[64] We do not rely on arguments that adopting stricter limits would be a material change from information made available to bidders in the 24 GHz auction and that licensees reasonably made investments based on the Resolution 750 limits. *See* CTIA Comments at 6; AT&T Reply Comments at 3-4 & n.12 (citing T-Mobile Comments at 4).

[65] *Notice* at para. 16. Point-to-multipoint operations include transportable user equipment, where the user equipment is not intended to be used while in motion, but the equipment could be moved when not in operation. *See* 47 CFR § 30.2. We agree with GuRu Wireless, Inc. that expansion of WRC-19 emissions limits to the Industrial, Scientific, and Medical (ISM) band is outside the scope of this proceeding. *See* GuRu Wireless, Inc. Comments at 2.

[66] *See* Nokia Reply Comments at 2.

[67] CORF asserts it cannot verify whether or not these point-to-point links have caused harmful interference to passive sensors at 23.6-24.0 GHz. CORF Comments at 9. Ericsson states that there are no known reports of interference from UMFUS services to EESS in the adjacent band. *See* Ericsson Comments at 3; Nokia Reply Comments at 2-3; *see also* IEEE GRSS Comments at 5 (stating "we do not have any information on whether interference has been detected by operational sensors").

[68] *See, e.g.*, Ericsson Comments at 3.

deployments increase in the band, we will monitor for potential issues, and, if necessary, consider whether to revisit the limits for fixed operations.

21. The Commission's *Notice* also directed proponents of applying the stricter limits to fixed operations to provide "specific technical data as well as the costs and benefits of applying stricter limits or of keeping the existing limits."[69] Neither proponents nor opponents of applying the Resolution 750 limits to fixed operations presented such technical or cost/benefit data. Indeed, IEEE GRSS, which supports applying the Resolution 750 limits to fixed, suggests that further studies are necessary.[70] CORF argues that "[i]t is counterproductive to protect passive uses from OOBE from mobile service equipment, but not from equipment used for UMFUS fixed services," and it "recommends that a rigorous OOBE standard apply to all UMFUS equipment operating at 24 GHz: UMFUS fixed point-to-point and point-to-multipoint equipment, as well as mobile equipment."[71] Given the differences between fixed and mobile operations, however, and the lack of any technical support, the conclusory arguments by CORF and others are insufficient to justify extending Resolution 750's mobile limits to fixed operations.

22. CTIA suggests that the Commission clarify that transportable stations (which it said are fixed stations) would not be subject to the more stringent emissions limits.[72] For purposes of these rules, we will use the definition of a mobile station contained in part 2 of our rules, "[a] station in the mobile service intended to be used while in motion or during halts at unspecified points."[73] In contrast, a transportable station, which our rules define as "[t]ransmitting equipment that is not intended to be used while in motion, but rather at stationary locations,"[74] operates under the fixed service allocation and would not be subject to the Resolution 750 limits. While transportable equipment is used in a limited number of stationary locations (such as a fixed modem at a home or office), mobile equipment could be used anywhere (for example, stopped at a red light).

23. NTIA asks that, as an alternative to applying the Resolution 750 limits to fixed operations, we mandate downtilt in fixed operations to avoid transmissions towards EESS satellites.[75] Because there may be situations where downtilt is not feasible (for example, a point-to-point link between two sites that differ in elevation), rather than mandating downtilt, we instead strongly encourage licensees to avoid uptilt where practical.

24. *Indoor small-cell systems.* The *Notice* also sought comment on Ericsson's and AT&T's proposal that indoor small-cell systems be exempt from the Resolution 750 limits.[76] In response to the *Public Notice*, Ericsson stated that there is a growing interest in indoor small cell deployments, the 24 GHz band may provide an opportunity to enhance indoor coverage, and the technical rules for such use cases should not deviate from what is currently allowed under part 30.[77] Ericsson further noted that "several mitigating factors, including wall and building entry losses and the potential for clutter losses from nearby buildings, mitigate the need for more stringent limits."[78] Arguing that indoor small cells are not governed by the WRC-19 agreement limits, CTIA contends that, because "indoor small cells are

[69] *Notice* at para. 17.

[70] *See* IEEE GRSS Comments at 5.

[71] CORF Comments at 8-9; *see also* AGU/AMS/NWA Comments at 12; NTIA Comments at 3.

[72] CTIA Comments at 7-8 (emphasis added).

[73] 47 CFR § 2.1.

[74] 47 CFR § 30.2

[75] NTIA Comments at 3.

[76] *Notice* at para. 18.

[77] Ericsson Jun. 28, 2021, Comments at 5-6 (Ericsson PN Comments).

[78] Ericsson PN Comments at 5.

installed inside of buildings, the mobile signal level is already reduced by hundreds to thousands of times…[and] as a result, the commercial mobile signals will be negligible at the satellite receiver, making tighter emissions levels for indoor small cells unnecessary."[79] T-Mobile agrees that exempting indoor small-cell systems would not harm passive sensors in the 23.6-24.0 GHz band because "indoor small-cell systems operate inside buildings at a lower power, making them subject to building attenuation."[80] It maintains that, "[d]ue to the propagation characteristics of signals from indoor small-cell systems, it is unlikely that those signals would propagate outdoors and even be recognized by, let alone cause harmful interference to, passive sensors."[81]

25. Other commenters oppose an exemption from the Resolution 750 limits for indoor small-cell systems. IEEE GRSS notes that "[m]icrowave signals are not necessarily attenuated by all building materials at these frequencies, and there is no assurance that equipment built for indoor use may not be improperly installed in an outdoor setting."[82] CORF recommends against such an exemption, "particularly for low-cost devices that may be deployed in large numbers,"[83] and it agrees that, while these devices typically operate at lower power, building entry loss serves to reduce emissions to a "lower but not necessarily acceptable level."[84] Similarly, NASA argues that, while indoor operations may provide additional signal blockage of those signals to NASA's passive sensors, this issue was not studied during WRC-19 to determine the potential impact from indoor small-cell operations on NASA missions.[85] NASA further notes that 'indoor-only' use limitations are difficult to enforce, and expressed concern that even a very small amount of hardware operating outside may pose impacts to NASA mission success.[86]

26. We conclude that the current record is insufficient to support exempting indoor base stations from the Resolution 750 limits, and decline to do so at this time. The current maximum power for UMFUS base stations is +75dBm/100 MHz.[87] Although some indoor operations may operate at lower power levels, and while there may be some power level at which indoor operations could be safely exempted, we lack a sufficient record on which to craft such an exemption. Although the Notice asked parties advocating for indoor exemption from Resolution 750 to provide technical justification,[88] no studies addressing the factors we would need to evaluate with respect to such an exemption were presented. These factors would include, for example: (1) propagation/penetration losses at 24 GHz, (2) the effect of building materials on such propagation/penetration losses, especially materials used in ceilings and roofs, since the receivers being protected are in the sky, and (3) the sensitive nature of the observations being made in the passive band. Given the insufficiency of the record, we decline to exempt indoor small-cell equipment from the Resolution 750 limits at this time.

D. Measurement of Unwanted Emissions

27. In the 24 GHz *Notice*, the Commission proposed to allow compliance with the unwanted emissions limits for the 23.6-24.0 GHz band to be demonstrated using TRP measurements, given that

[79] CTIA Comments at 8.

[80] T-Mobile Comments at 7.

[81] T-Mobile Comments at 7; *see also* Nokia Reply Comments at 2.

[82] IEEE GRSS Comments at 5.

[83] CORF Comments at 10.

[84] CORF Comments at 10.

[85] NASA Comments at 2; *see also* NOAA Comments at 13.

[86] NASA Comments at 2.

[87] *See* 47 CFR § 30.202(a).

[88] *Notice* at para. 18.

Resolution 750 specifies the limits in terms of TRP.[89] Total radiated power is a measure of how much power is radiated by an antenna when the antenna is connected to an actual radio (or transmitter). TRP is an active measurement in that a powered transmitter is used to transmit through the antenna. The total received power is calculated and summed up over all possible angles (hence, it is a spherical or three dimensional measurement).[90] The *Notice* also sought comment on whether to permit use of conductive power measurements as well.[91] Maximum conducted output power[92] measurements do not take into account the efficiency of the antenna.[93]

28. We will allow the use of both TRP and maximum conductive output power measurements to ensure compliance with the limits on emissions into the 23.6-24 GHz band, consistent with the part 30 rules applicable in other UMFUS bands.[94] As CTIA and Nokia observe, OET has issued a knowledge database ("KDB") document that permits both TRP and maximum conducted output power measurement procedures to demonstrate regulatory compliance for UMFUS devices.[95] In our experience, maximum conducted output power measurements have worked well in these bands, and allowing use of either TRP or maximum conducted output power measurements would provide equipment manufacturers with maximum flexibility as they develop equipment for the 24 GHz band. We see no reason to treat the 24 GHz band differently from other UMFUS bands.

29. We find the arguments that certain commenters have raised against allowing conductive power measurements to be unpersuasive. We acknowledge, as IEEE GRSS, NTIA, NOAA, and NASA point out, that the WRC-19 studies relied on TRP to develop the Resolution 750 standards.[96] By itself, however, that fact does not mean that maximum conducted output power measurements cannot be used to demonstrate compliance. NASA argues that conductive power methodology does not provide an accurate characterization of the aggregate effects of systems' components on the measurement results, and it asserts that TRP and conductive power measurements methodologies may produce different quantitative limits for unwanted emissions.[97] We note that conductive power measurements are more conservative than TRP. In other words, if a conductive power measurement shows compliance, the corresponding TRP measurement will demonstrate compliance as well (although the converse will not necessarily be true).

[89] *Notice* at para. 8.

[90] *See* https://www.antenna-theory.com/definitions/trp.php. TRP can also be defined as the integral of the power transmitted from all antenna elements in different directions over the entire radiation sphere. *See* ITU Radio Regulations (2020), Resolution 750 (Rev.WRC-19), Note 5, Vol. 3 at 522.

[91] *Notice* at para. 8.

[92] *See* 47 CFR § 15.403.

[93] TRP of a transmitter is closely related to its conductive power. In fact, TRP is product of antenna radiation efficiency,e_r, and conductive power P ($TRP = e_rP$), and depending on antenna efficiency, TRP can be virtually the same as the conductive power P. *See* W.L. Stutzman and Gary A. Thiele, *Antenna Theory and Design*, 2013, equations 13-40 and 2-155.

[94] 47 CFR § 30.203(a). We will also add the existing definition of "maximum conducted output power" contained in our part 15 rules into our part 30 rules. See 47 CFR § 30.2.

[95] *See* Nokia Reply Comments at 4-5 & n.8 (citing *Basic Certification Requirements and Measurement Procedures for Upper Microwave Flexible Use Services (UMFUS) Devices*, FCC Office of Engineering and Technology Laboratory Division, Knowledge Database (KDB) publication, KDB 842590 D01 (Apr. 20, 2021) https://apps.fcc.gov/kdb/GetAttachment.html?id=yV3FexQrXZMe%2F42JGriFdg; *see also* CTIA Comments at 9-10 & n.25.

[96] *See* IEEE GRSS Comments at 8; NASA Comments at 2; NOAA Comments at 14; *see also* NTIA Jun. 28, 2021, Comments at 12.

[97] NASA Comments at 2.

Accordingly, allowing conductive power measurements does not present a substantial risk that noncompliant equipment will be placed into the marketplace.

30. In addition, parties against allowing conductive power measurements argue that the TRP methodology is clearly understood,[98] and NOAA points to Ericsson's prior statement that it does not anticipate difficulties performing TRP measurements.[99] While there is broad support for allowing TRP measurements, such measurements require use of an anechoic chamber, which imposes additional costs, and may not be available to all stakeholders. We disagree with NASA's claim that using measurement techniques other than TRP would require significant further technical analysis.[100] The Commission has allowed licensees and equipment manufacturers to perform conductive power measurements in other UMFUS bands for many years, pursuant to the KDB guidance discussed above,[101] and using conductive power to measure compliance with the Resolution 750 limits does not present any unique new issues. While AGU, AMS and NWA argue that the calculations required for OOBE measurements are not straightforward and allowing the use of multiple measurement methods by the industry "would only contribute to the difficulty,"[102] they do not precisely explain what they perceive the difficulty to be. Finally, CORF argues that many 24 GHz devices will not have clean access to an antenna port, and even devices with access to the radiating element's port may radiate unintentionally from other parts of the equipment being tested.[103] In those cases where there is no clear access to an antenna port, we anticipate that TRP will be used. So long as equipment manufacturers follow the guidance we have issued, we see no reason why conductive power measurements cannot work here, as they do in other UMFUS bands. Accordingly, we will allow compliance with the emissions limits for equipment certification in the 24 GHz band to be demonstrated by measurements showing that either TRP or maximum conducted output power is within the limits set in Resolution 750.

E. Timetable for Application of WRC-19 Limits

31. *Phase 1 to Phase 2 Transition Timetable.* Having decided to transition to the WRC-19 Resolution 750 OOBE limit regime for the 24 GHz band, we must still determine *when* that transition will take place – i.e., the appropriate timetable for moving to stricter limits, as well as *how* it will occur – and the practical steps necessary for transitioning equipment to the stricter limits. The *Notice* proposed to apply the new Resolution 750 unwanted emissions limits on the timetable adopted at WRC-19.[104] This timing is set forth in two footnotes to Resolution 750, that state:

> [a] A limit of −39 dB(W/200 MHz) will apply to IMT base stations brought into use after 1 September 2027. This limit will not apply to IMT base stations which have been brought into use prior to this date. For those IMT base stations, the limit of −33 dB(W/200 MHz) will continue to apply after this date.
>
> and
>
> [b] A limit of −35 dB(W/200 MHz) will apply to IMT mobile stations brought into use after 1 September 2027. This limit will not apply to IMT mobile stations which have been brought into

[98] *See, e.g.*, NTIA Comments at 4.

[99] NOAA Comments at 14; *see also* Ericsson PN Comments at 4.

[100] NASA Comments at 2.

[101] *See supra* n.95.

[102] *See* AGU/AMS/NWA Comments at 12.

[103] *See* CORF Comments at 10-11.

[104] *See Notice* at paras. 5 (Table 1), 10 & 24.

> use prior to this date. For those IMT mobile stations, the limit of −29 dB(W/200 MHz) will continue to apply after this date.[105]

32. We adopt the WRC-19 timetable as proposed in the *Notice*. The first phase limits (–33 dBW/200 MHz for base stations, –29 dBW/200 MHz for mobile stations) will apply as of the effective date of the rules,[106] and the second phase limits (–39 dBW/200 MHz for base stations, –35 dBW/200 MHz for mobile stations) will apply to all deployments brought into use (i.e., constructed and operating) after September 1, 2027. This schedule strikes an appropriate balance between protecting weather and scientific observations and promoting deployment in the 24 GHz band.[107] Various commenters support adopting the WRC-19 schedule.[108] Moreover, we wish to incentivize the work of manufacturers like Ericsson, which asserts it has already produced equipment meeting the Phase 1 limit.[109]

33. We decline to accelerate the effective date of the Phase 2 standards, as requested by NOAA, IEEE GRSS, and AGU/AMS/NWA.[110] There is considerable uncertainty as to when equipment meeting Phase 2 standards will be available. Implementing Phase 2 standards prematurely could make it impractical for licensees to deploy in the band. Finally, while WRC-19 contemplated that there could be a longer period (up to eight years) where Phase 1 equipment could be deployed, in fact deployments will be required to comply with Phase 2 in fewer than three years. Accordingly, it appears that the number of deployments using Phase 1 equipment may be lower than originally contemplated at WRC-19.

34. We also reject T-Mobile's suggestion that the more stringent Phase 2 limits should only apply to equipment "authorized for use" after September 1, 2027, but that equipment could be "brought into use" after that date even if it was certified prior to that date and only complied with the Phase 1 limits.[111] T-Mobile argues that purchased and certified equipment that only meets the Phase 1 limit but is unused due to certain delays beyond the control of the provider should be allowed be installed even after September 1, 2027; in other words, that providers should be permitted to use any equipment that was manufactured and sold before September 1, 2027, indefinitely under the Phase 1 limits so long as that equipment has been approved for use by the Commission prior to that date.[112] We disagree with this position because we believe this could act as an incentive for entities to stock up on equipment that met the Phase 1 limit in order to deploy this equipment at their leisure during Phase 2, effectively allowing an 'end-run' around the very concept of implementing the Phase 2 limit after September 1, 2027. T-Mobile's interpretation is plainly inconsistent with what was contemplated at WRC-19. From the perspective of the ITU, equipment that is certified but also "brought into use" prior to September 1, 2027, will be 'grandfathered' – i.e., allowed to continue to operate at the prior emissions limits even after implementation of the stricter emissions limits regime. But there is indeed a defined limit based on when equipment is 'brought into use.' As the Commission stated in the *Notice*,

> Because the unwanted emission limits for base stations and mobile stations will change after September 1, 2027 under our proposal, equipment certifications based on compliance with the

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[105] *See* ITU Radio Regulations (2020), Resolution 750 (Rev.WRC-19), Notes to Table 1, Vol. 3 at 522, https://www.itu.int/en/myitu/Publications/2020/09/02/14/23/Radio-Regulations-2020.

[106] *See* NOAA Comments at 11 (urging Commission to make Phase 1 limits effective immediately). The rules we adopt in this item will be effective 30 days after Federal Register publication of the item. *See infra* para. 47.

[107] *See Notice* at para.11; *accord* AT&T Comments at 3.

[108] *See* AT&T Comments at 3; CTIA Comments at 10; T-Mobile Comments at 9; NTIA Comments at 4; *see also* AT&T Reply Comments at 4.

[109] Ericsson Comments at 4.

[110] *See* NOAA Comments at 11; IEEE GRSS Comments at 6-7; *see also* AGU/AMS/NWA Comments at 10-11.

[111] T-Mobile Reply Comments at 6-7.

[112] T-Mobile Comment at 11.

first phase limits would expire on that date. Any equipment remaining in the supply chain—i.e. in warehouses or in transit—*would then be illegal to sell or install under our rules*.[113]

35. We reiterate that, under the rules we adopt today, any equipment "brought into use" after September 1, 2027 must be "authorized for use" – i.e., certified for use - according to the Phase 2 limits of Resolution 750. We also reject IEEE GRSS's argument that the ITU intended that "all base station equipment that does not comply with the -39 dBW/200 MHz limit should be modified or removed by September 1, 2028."[114] If Phase 1 equipment was brought into use on August 31, 2027, it can continue to operate after September 1, 2027 per the ITU's footnote clarifications, even though it may not meet the increased OOBE limits. We find that it serves the public interest to use the ITU's footnote clarifications for a clear and effective application of the time table for the limits.

36. *Certification of Phase 1 Equipment*. The Commission also sought comment in the *Notice* on how to transition equipment deployed under the Phase 1 limits and to incentivize early and timely development and deployment of Phase 2 equipment.[115] The *Notice* pointed to the equipment authorization program for RF devices as one tool meant to ensure compliance with the technical rules.[116] RF devices must comply with the Commission's technical and equipment authorization requirements before they can be imported into or marketed in the United States.[117] Because under our proposal, the unwanted emissions limits for base stations and mobile stations will change on September 1, 2027, equipment certifications based on compliance with the first phase limits would no longer be granted on or after this date. Furthermore, as noted above, any equipment remaining in the supply chain—i.e. in warehouses or in transit—would then be illegal to sell or install under the rules.[118] In the *Notice*, the Commission sought comment on whether it should prohibit the grant of new equipment certifications for, or the importation of, equipment not complying with the Phase 2 unwanted emissions limits at a date prior to September 1, 2027, as a means of both preventing equipment certified as complying only with Phase 1 limits from remaining in the supply chain – in warehouses or in transit – or being brought into use after September 1, 2027.[119] As an example, the Commission stated that it could cease granting new equipment certifications or cease permitting importation of equipment only meeting the first phase limit after March 1, 2027, or six months prior to implementation of the second phase limits.[120]

37. We decline to accelerate the deadline for equipment certification of Phase 1 equipment since we do not believe that it would incentivize the early development and deployment of Phase 2 equipment, but instead may place additional burdens on large and small equipment manufacturers and carriers planning their own affairs. The benefits touted by proponents of setting an earlier certification deadline rely on arguments that we do not find persuasive in light of the licensing and compliance paradigm we clarify today.[121] Under the interpretation of Resolution 750 limits for the 24 GHz band that

[113] *Notice* at para. 20 (emphasis added).

[114] IEEE GRSS Comments at 5-6.

[115] *Notice* at para. 22

[116] *Notice* at para. 20.

[117] *Notice* at para. 20 (citing 47 CFR §§ 2.803, 30.201).

[118] *See Notice* at para. 20.

[119] *Notice* at para. 20.

[120] *Notice* at para. 20.

[121] *See* NTIA Comments at 3 (advocating for a March 1, 2027 equipment certification deadline); IEEE GRSS Comments at 5-6 (recommending the Commission to cease granting Phase 1 certifications on January 1, 2027, but as part of an overall proposal by IEEE GRSS that all equipment not complying with Phase 2 limits be replaced by Sept. 1, 2028); AGU/AMS/NWA Comments at 10-11 (recommending the Commission prohibit grants of new equipment certificates or importation of equipment that is not in compliance with the Phase 2 limits as of January 1, 2027); Qualcomm Comments at 2-3 (recommending the Commission to cease granting Phase 1 certifications on September (continued….)

we adopt and incorporate into our rules today, equipment meeting the Phase 1 limits can be brought into use up through September 1, 2027, and can remain in use thereafter. Accordingly, we see no need to stop certifying Phase 1 equipment before September 1, 2027. We emphasize that the September 1, 2027 deadline for bringing Phase 1 equipment into use is firm, and equipment manufacturers and licensees must keep that firm deadline in mind when deciding to develop or to purchase Phase 1 equipment. Any decision to develop or to purchase equipment that does not meet Phase 2 emissions limits close to the September 1, 2027 deadline will be solely at the risk of the equipment manufacturer or licensee, and we presume that they will plan accordingly. This decision trusts equipment manufacturers and carriers to structure their own affairs, gives them a well-defined timeline to do so, and removes any disincentive for manufacturers to prematurely cease producing equipment that meets Phase 1.[122]

38. *Requiring Phase 1 Equipment to Transition to Phase 2.* The Commission also sought comment in the *Notice* on what should happen with Phase 1 equipment still operating after the Phase 2 deadline.[123] NTIA, NOAA, and NASA advocate that equipment modified or replaced after September 1, 2027, must meet the more stringent Phase 2 OOBE levels.[124] AGU/AMS/NWA, IEEE GRSS, and NOAA ask that base station and user equipment that does not comply with the -39 dBW/200 MHz limit be given a sunset date of September 1, 2028, by which it must be modified/retrofitted to meet the more stringent limits or removed.[125]

39. We decline to establish a hard date by which Phase 1 equipment brought into use on or prior to September 1, 2027, must comply with the Phase 2 limits, subject to certain conditions, as explained further below. Establishing a hard sunset date would be inconsistent with the WRC-19 framework, which contemplates that Phase 1 equipment brought into use prior to September 1, 2027, could be operated indefinitely. Furthermore, the proponents of a hard sunset date have not offered any technical justification for such a sunset date, nor have they cited any factor that was allegedly not considered at WRC-19.

40. Rather, we will adopt NTIA's proposal to require that equipment modified or replaced after September 1, 2027, must meet the more stringent Phase 2 emissions limits, clarified by CTIA and T-Mobile's suggestion that, for purposes of this requirement, only base station modifications that affect emission characteristics would constitute a "modification" requiring compliance with the Phase 2 limits.[126] We believe these decisions strike the appropriate balance between granting licensees flexibility

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1, 2026, as this will ensure that majority of equipment placed into service after September 1, 2027 will be compliant because requiring removal of Phase 1 equipment from the supply chain after September 1, 2027 will be difficult, costly and time-consuming).

[122] *See* Nokia Reply Comments at 4 ("Establishing an earlier date for ceasing equipment authorization for the first phase could preclude mobile operators from deploying equipment compliant with those limits while still in the first phase time frame, which in practice would mean an anticipation of the time frame agreed in WRC-19 for the second phase unwanted emissions limits. A well-defined and definite timeline for the two-phase unwanted emissions limits should allow industry to comply with the established two-phased requirements taking into account the Commission's process for equipment authorization"); *see also* Ericsson Comments at 5 ("[B]y declining to grant new equipment certifications beginning six months before the implementation for the second phase limits, [the Commission] would effectively accelerate the WRC-19 implementation timeline. Equipment manufacturers and their customers should flexibility to deploy new first phase 24 GHz equipment up until September 1, 2027, without restriction.").

[123] *Notice* at para. 24.

[124] NTIA Comments at 4; NASA Comments at 2 (NASA defines this modification or replacement as "any physical or electrical modifications to the systems").

[125] AGU/AMS/NWA Comments at 11; IEEE GRSS Comments at 5; NOAA Comment at 12.

[126] *See* CTIA Comments at 11 & n.29 (citing Reply Comments of T-Mobile, ET Docket No. 21-186, at 4 (filed July 26, 2021) ("T-Mobile agrees that equipment that is "replaced" after September 1, 2027 should be treated as if it is
(continued….)

and being consistent with the decisions made at WRC-19. On the one hand, allowing licensees to make "modifications" to equipment without restriction could result in equipment that is substantially different from what is initially deployed not being subject to the Phase 2 limits. On the other hand, there are many sorts of routine modifications that could be made to equipment that would have no impact on the equipment's compliance with the Resolution 750 limits. As CTIA notes, requiring that any modification trigger compliance with the Phase 2 limits would be overly broad and would effectively preclude licensees from making any changes to existing deployments without purchasing and installing entirely new equipment.[127] We see no reason why those sorts of routine modifications should trigger a requirement to replace that equipment. Since the emission characteristics are critical here, we conclude that only modifications that would change the emission characteristics of the equipment would constitute a "modification" that would trigger a requirement to comply with the Phase 2 emissions limits. We also conclude that any equipment that is completely replaced after September 1, 2027 should be treated as if it is newly installed and therefore subject to the post-September 1, 2027 emissions limits of the ITU Resolution 750.[128]

IV. PROCEDURAL MATTERS

41. *Regulatory Flexibility Act*. The Regulatory Flexibility Act of 1980, as amended (RFA),[129] requires that an agency prepare a regulatory flexibility analysis for notice-and-comment rulemakings, unless the agency certifies that "the rule will not, if promulgated, have a significant economic impact on a substantial number of small entities."[130] Accordingly, we have prepared a Final Regulatory Flexibility Analysis (FRFA) concerning the possible impact of the rule changes contained in this *Report and Order*. The FRFA is set forth in Appendix B.

42. *Paperwork Reduction Act.* This document does not contain new or modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. In addition, therefore, it does not contain any new or modified information collection burden "for small business concerns with fewer than 25 employees," pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. § 3506(c)(4).

43. *Congressional Review Act.* The Commission has determined, and the Administrator of the Office of Information and Regulatory Affairs, Office of Management and Budget, concurs, that this rule is non-major under the Congressional Review Act, 5 U.S.C. § 804(2). The Commission will send a copy of this Report & Order to Congress and the Government Accountability Office pursuant to 5 U.S.C. § 801(a)(1)(A).

44. *People with Disabilities*. To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to fcc504@fcc.gov or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice).

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newly installed and therefore subject to the post-September 1, 2027 emission limits of ITU Resolution 750. But, as the Commission is aware, base station equipment may be "modified" in many ways, not all of which are meaningful. There should be no requirement to conform existing equipment to the 2027 emission limits unless the base station modification affects the emission characteristics of the base station's transmitter.").

[127] *See* CTIA Comments at 11.

[128] *See* T-Mobile Reply Comments at 4 (commenting that equipment that is "replaced" after September 1, 2027 should be treated as if it is newly installed and therefore subject to the post-September 1, 2027 emission limits of ITU Resolution 750).

[129] 5 U.S.C. §§ 601–612. The RFA has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

[130] 5 U.S.C. § 605(b).

45. *Contact Persons*. For further information contact Simon Banyai of the Wireless Telecommunications Bureau, Broadband Division, at 202-418-1443 or by e-mail to Simon.Banyai@fcc.gov.

V. ORDERING CLAUSES

46. Accordingly, IT IS ORDERED, pursuant to sections 4(i), 301, 302, 303(r), 308, 309, and 333 of the Communications Act of 1934, 47 U.S.C. §§ 154(i), 301, 302a, 303(r), 308, 309, 333, that this Report and Order IS HEREBY ADOPTED.

47. IT IS FURTHER ORDERED that sections 2.106 and 30.203 of the Commission's rules ARE AMENDED as specified in Appendix A, and such rule amendments WILL BECOME EFFECTIVE 30 days after the date of publication in the *Federal Register*.

48. 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.

49. IT IS FURTHER ORDERED that the Office of the Managing Director, Performance 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).

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

Final Rules

For the reasons discussed in the document above, the Federal Communications Commission amends 47 CFR parts 2 and 30 as follows:

PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS

1. The authority citation for part 2 continues to read as follows:

Authority: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

2. Amend § 2.106 in paragraph (a) by revising pages 54 and 55 and add paragraph (c)(146) to read as follows:

§ 2.106 Table of Frequency Allocations

(a) * * *

* * * * *

22-22.21 FIXED MOBILE except aeronautical mobile 5.149			22-22.21 FIXED MOBILE except aeronautical mobile US342		
22.21-22.5 EARTH EXPLORATION-SATELLITE (passive) FIXED MOBILE except aeronautical mobile RADIO ASTRONOMY SPACE RESEARCH (passive) 5.149 5.532			22.21-22.5 EARTH EXPLORATION-SATELLITE (passive) FIXED MOBILE except aeronautical mobile RADIO ASTRONOMY SPACE RESEARCH (passive) US342 US532		
22.5-22.55 FIXED MOBILE			22.5-22.55 FIXED MOBILE US211		
22.55-23.15 FIXED INTER-SATELLITE 5.338A MOBILE SPACE RESEARCH (Earth-to-space) 5.532A 5.149			22.55-23.15 FIXED INTER-SATELLITE US145 US278 MOBILE SPACE RESEARCH (Earth-to-space) 5.532A US342		Satellite Communications (25) Fixed Microwave (101)
23.15-23.55 FIXED INTER-SATELLITE 5.338A MOBILE			23.15-23.55 FIXED INTER-SATELLITE US145 US278 MOBILE		
23.55-23.6 FIXED MOBILE			23.55-23.6 FIXED MOBILE		Fixed Microwave (101)
23.6-24 EARTH EXPLORATION-SATELLITE (passive) RADIO ASTRONOMY SPACE RESEARCH (passive) 5.340			23.6-24 EARTH EXPLORATION-SATELLITE (passive) RADIO ASTRONOMY US74 SPACE RESEARCH (passive) US246		
24-24.05 AMATEUR AMATEUR-SATELLITE 5.150			24-24.05 5.150 US211	24-24.05 AMATEUR AMATEUR-SATELLITE 5.150 US211	ISM Equipment (18) Amateur Radio (97)
24.05-24.25 RADIOLOCATION Amateur Earth exploration-satellite (active) 5.150			24.05-24.25 RADIOLOCATION G59 Earth exploration-satellite (active) 5.150	24.05-24.25 Amateur Earth exploration-satellite (active) Radiolocation 5.150	RF Devices (15) ISM Equipment (18) Private Land Mobile (90) Amateur Radio (97)
24.25-24.45 FIXED MOBILE except aeronautical mobile 5.338A 5.532AB	24.25-24.45 FIXED 5.532AA MOBILE except aeronautical mobile 5.338A 5.532AB RADIONAVIGATION	24.25-24.45 FIXED MOBILE 5.338A 5.532AB RADIONAVIGATION	24.25-24.45	24.25-24.45 FIXED MOBILE US146	RF Devices (15) Upper Microwave Flexible Use (30)

International Table			United States Table		FCC Rule Part(s)
Region 1 Table	Region 2 Table	Region 3 Table	Federal Table	Non-Federal Table	
24.45-24.65 FIXED INTER-SATELLITE MOBILE except aeronautical mobile 5.338A 5.532AB	24.45-24.65 FIXED 5.532AA INTER-SATELLITE MOBILE except aeronautical mobile 5.338A 5.532AB RADIONAVIGATION 5.533	24.45-24.65 FIXED INTER-SATELLITE MOBILE 5.338A 5.532AB RADIONAVIGATION 5.533	24.45-24.65 INTER-SATELLITE RADIONAVIGATION 5.533		RF Devices (15) Satellite Communications (25)
24.65-24.75 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B ER-SATELLITE MOBILE except aeronautical mobile 5.338A 5.532AB	24.65-24.75 FIXED 5.532AA INTER-SATELLITE MOBILE except aeronautical mobile 5.338A 5.532AB RADIOLOCATION-SATELLITE (Earth-to-space)	24.65-24.75 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE 5.338A 5.532AB	24.65-24.75 INTER-SATELLITE RADIOLOCATION-SATELLITE (Earth-to-space)		
24.75-25.25 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B MOBILE except aeronautical mobile 5.338A 5.532AB	24.75-25.25 FIXED 5.532AA FIXED-SATELLITE (Earth-to-space) 5.535 MOBILE except aeronautical mobile 5.338A 5.532AB	24.75-25.25 FIXED FIXED-SATELLITE (Earth-to-space) 5.535 MOBILE 5.338A 5.532AB	24.75-25.25	24.75-25.25 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE US146 NG65	RF Devices (15) Satellite Communications (25) Upper Microwave Flexible Use (30)
25.25-25.5 FIXED 5.534A INTER-SATELLITE 5.536 MOBILE 5.338A 5.532AB Standard frequency and time signal-satellite (Earth-to-space)			25.25-25.5 FIXED INTER-SATELLITE 5.536 MOBILE US146 Standard frequency and time signal-satellite (Earth-to-space)	25.25-25.5 Inter-satellite 5.536 Standard frequency and time signal-satellite (Earth-to-space)	RF Devices (15)
25.5-27 EARTH EXPLORATION-SATELLITE (space-to-Earth) 5.536B FIXED 5.534A INTER-SATELLITE 5.536 MOBILE 5.338A 5.532AB SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) 5.536A			25.5-27 EARTH EXPLORATION-SATELLITE (space-to-Earth) FIXED INTER-SATELLITE 5.536 MOBILE US146 SPACE RESEARCH (space-to-Earth) Standard frequency and time signal-satellite (Earth-to-space) 5.536A US258	25.5-27 SPACE RESEARCH (space-to-Earth) Inter-satellite 5.536 Standard frequency and time signal-satellite (Earth-to-space) 5.536A US258	
27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE 5.338A 5.532AB	27-27.5 FIXED 5.534A FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE 5.338A 5.532AB		27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE US146	27-27.5 Inter-satellite 5.536	
27.5-28.5 FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.517A 5.539 MOBILE 5.538 5.540			27.5-30	27.5-28.35 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE	RF Devices (15) Satellite Communications (25) Upper Microwave Flexible Use (30) Fixed Microwave (101)
				28.35-29.1 FIXED-SATELLITE (Earth-to-space) G165 NG527A	RF Devices (15) Satellite Communications (25)

* * * * *

(c) * * *

(146) US146 In the bands 24.25-24.45 GHz and 24.75-27.5 GHz, the maximum conducted output power or the total radiated power (TRP) of emissions from stations in the mobile service in any 200 MHz of the band 23.6-24 GHz shall not exceed -33 dBW/200 MHz for base stations and -29 dBW/200 MHz for mobile stations, and for stations brought into use after September 1, 2027, the maximum conducted output power or TRP shall not exceed -39 dBW/200 MHz for base stations and -35 dBW/200 MHz for mobile stations. If equipment brought into use on or prior to September 1, 2027 is replaced, or modified in a manner that changes the emissions characteristics of the equipment, the equipment must then comply with the -39 dBW/200 MHz limit for base stations and -35 dBW/200 MHz limit for mobile stations.

* * * * *

PART 30 – UPPER MICROWAVE FLEXIBLE USE SERVICE.

3. The authority citation for part 30 continues to read as follows:

Authority: 47 U.S.C. 151, 152, 153, 154, 301, 303, 304, 307, 309, 310, 316, 332, 1302, unless otherwise noted.

4. Amend § 30.2 by adding the definition of "Maximum Conducted Output Power" in alphabetical order to read as follows:

§ 30.2 Definitions.

* * * * *

Maximum Conducted Output Power. The total transmit power delivered to all antennas and antenna *elements* averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (*e.g.*, alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

* * * * *

5. Amend § 30.203 by revising the section heading and add paragraph (d) to read as follows:

§ 30.203 Emissions limits.

* * * * *

(d)(1) In addition to the limits noted above, for licensees operating mobile equipment in the 24.25-24.45 GHz or 24.75-25.25 GHz bands, the maximum conducted output power or the total radiated power of emissions in any 200 MHz of the 23.6-24.0 GHz band shall not exceed -33 dBW (for base stations) or -29 dBW (for mobile stations).

(2) For mobile equipment brought into use after September 1, 2027, the maximum conducted output power or the total radiated power of emissions in any 200 MHz of the 23.6-24.0 GHz band shall not exceed -39 dBW (for base stations) or -35 dBW (for mobile stations). If equipment brought into use on or prior to September 1, 2027 is replaced, or modified in a manner that changes the emissions characteristics of the equipment, the equipment must then comply with the emissions limits in this paragraph.

APPENDIX B

Final Regulatory Flexibility Analysis

1. As required by the Regulatory Flexibility Act of 1980, as amended (RFA),[1] an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Modifying Emissions Limits for the 24.25-24.45 GHz and 24.75-25.25 GHz Band, Notice of Proposed Rulemaking* (*Notice*) released in December 2023.[2] The Federal Communications Commission (Commission) sought written public comment on the proposals in the *Notice*, including comment on the IRFA.[3] No comments were filed addressing the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.[4]

A. Need for, and Objectives of, the Final Rules

2. The *Report and Order* (*Report and Order*) adopted by the Commission today implements certain decisions regarding the 24.25-27.5 GHz band made in the World Radiocommunication Conference held by the International Telecommunication Union (ITU) in 2019 (WRC-19). The Commission aligns part 30 of its rules for mobile operations with the Resolution 750 limits on unwanted emissions into the passive 23.6-24.0 GHz band that were adopted at WRC-19, and specifically: (1) applies the Resolution 750 unwanted OOBE limits to all mobile operations; (2) declines to adopt limits more stringent than those imposed by Resolution 750; (3) declines to apply the Resolution 750 limits to fixed operations, including point-to-point and point-to-multipoint systems; (4) declines to exempt indoor small-cell equipment from the Resolution 750 limits; (5) allows the demonstration of compliance with the unwanted emissions limits for the 23.6-24.0 GHz band using both conducted power measurement methodology in addition to the Total Radiated Power (TRP) methodology; and (6) sets the timetable for application of Resolution 750 limits. These rule changes and decisions will promote international harmonization, help to facilitate the protection of passive sensors used for weather forecasting and scientific research in the 23.6 GHz-24.0 GHz band, while continuing to promote flexible commercial use of the 24.25-24.45 GHz and 24.75-25.25 GHz bands (collectively, 24 GHz band).

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

3. 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

4. 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.[5] The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

[1] 5 U.S.C. § 603. The RFA, 5 U.S.C. §§ 601-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996, (SBREFA) Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

[2] *Modifying Emission Limits for the 24.25-24.45 GHz and 24.75-25.25 GHz Band*, ET Docket No. 21-186, Notice of Proposed Rulemaking, FCC 23-114, 2023 WL 8946049, (rel. Dec. 22, 2023) (*Notice*).

[3] *See generally Notice*.

[4] 5 U.S.C. § 604.

[5] *Id*. § 604 (a)(3).

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

5. 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 rules adopted herein.[6] The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[7] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[8] 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.[9]

6. *Small Businesses, Small Organizations, Small Governmental Jurisdictions*. Our actions, over time, may affect small entities that are not easily categorized at present. We therefore describe, at the outset, three broad groups of small entities that could be directly affected herein.[10] 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.[11] These types of small businesses represent 99.9% of all businesses in the United States, which translates to 33.2 million businesses.[12]

7. 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."[13] 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.[14] Nationwide, for tax year 2022, there were approximately 530,109 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.[15]

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[6] *Id.* § 604(a)(44).

[7] *Id.* § 601(6).

[8] *Id*. § 601(3) (incorporating by reference the definition of "small-business concern" in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

[9] 15 U.S.C. § 632.

[10] 5 U.S.C. § 601(3)-(6).

[11] *See* SBA, Office of Advocacy, "What's New With Small Business?," (Mar. 2023), https://advocacy.sba.gov/wp-content/uploads/2023/03/Whats-New-Infographic-March-2023-508c.pdf.

[12] *Id*.

[13] 5 U.S.C. § 601(4).

[14] The IRS benchmark is similar to the population of less than 50,000 benchmark in 5 U.S.C § 601(5) that is used to define a small governmental jurisdiction. Therefore, the IRS benchmark has been used to estimate the number of small organizations in this small entity description. S*ee* Annual Electronic Filing Requirement for Small Exempt Organizations – Form 990-N (e-Postcard), "Who must file,". We note that the IRS data does not provide information on whether a small exempt organization is independently owned and operated or dominant in its field.

[15] *See* Exempt Organizations Business Master File Extract (EO BMF), "CSV Files by Region,". The IRS Exempt Organization Business Master File (EO BMF) Extract provides information on all registered tax-exempt/non-profit organizations. The data utilized for purposes of this description was extracted from the IRS EO BMF data for businesses for the tax year 2022 with revenue less than or equal to $50,000 for Region 1-Northeast Area (71,897), Region 2-Mid-Atlantic and Great Lakes Areas (197,296), and Region 3-Gulf Coast and Pacific Coast Areas

(continued….)

8. 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."[16] U.S. Census Bureau data from the 2022 Census of Governments[17] indicate there were 90,837 local governmental jurisdictions consisting of general purpose governments and special purpose governments in the United States.[18] Of this number, there were 36,845 general purpose governments (county,[19] municipal, and town or township[20]) with populations of less than 50,000 and 11,879 special purpose governments (independent school districts[21]) with enrollment populations of less than 50,000.[22] Accordingly, based on the 2022 U.S. Census of Governments data, we estimate that at least 48,724 entities fall into the category of "small governmental jurisdictions."[23]

9. *Wireless Telecommunications Carriers (except Satellite).* This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves.[24] 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.[25] The SBA size standard for this industry classifies a business as small if it has

(Continued from previous page)
(260,447) that includes the continental U.S., Alaska, and Hawaii. This data includes information for Puerto Rico (469).

[16] 5 U.S.C. § 601(5).

[17] 13 U.S.C. § 161. The Census of Governments survey is conducted every five (5) years compiling data for years ending with "2" and "7". *See also* Census of Governments, https://www.census.gov/programs-surveys/economic-census/year/2022/about.html.

[18] *See* U.S. Census Bureau, 2022 Census of Governments – Organization Table 2. Local Governments by Type and State: 2022 [CG2200ORG02], https://www.census.gov/data/tables/2022/econ/gus/2022-governments.html. Local governmental jurisdictions are made up of general purpose governments (county, municipal and town or township) and special purpose governments (special districts and independent school districts). *See also* tbl.2. CG2200ORG02 Table Notes_Local Governments by Type and State_2022.

[19] *See id.* at tbl.5. County Governments by Population-Size Group and State: 2022 [CG2200ORG05], https://www.census.gov/data/tables/2022/econ/gus/2022-governments.html. There were 2,097 county governments with populations less than 50,000. This category does not include subcounty (municipal and township) governments.

[20] *See id.* at tbl.6. Subcounty General-Purpose Governments by Population-Size Group and State: 2022 [CG2200ORG06], https://www.census.gov/data/tables/2022/econ/gus/2022-governments.html. There were 18,693 municipal and 16,055 town and township governments with populations less than 50,000.

[21] *See id.* at tbl.10. Elementary and Secondary School Systems by Enrollment-Size Group and State: 2022 [CG2200ORG10], https://www.census.gov/data/tables/2022/econ/gus/2022-governments.html. There were 11,879 independent school districts with enrollment populations less than 50,000. *See also* tbl.4. Special-Purpose Local Governments by State Census Years 1942 to 2022 [CG2200ORG04], CG2200ORG04 Table Notes_Special Purpose Local Governments by State_Census Years 1942 to 2022.

[22] While the special purpose governments category also includes local special district governments, the 2022 Census of Governments data does not provide data aggregated based on population size for the special purpose governments category. Therefore, only data from independent school districts is included in the special purpose governments category.

[23] This total is derived from the sum of the number of general purpose governments (county, municipal and town or township) with populations of less than 50,000 (36,845) and the number of special purpose governments - independent school districts with enrollment populations of less than 50,000 (11,879), from the 2022 Census of Governments - Organizations tbls. 5, 6 & 10.

[24] *See* U.S. Census Bureau, *2017 NAICS Definition, "517312 Wireless Telecommunications Carriers (except Satellite),"* https://www.census.gov/naics/?input=517312&year=2017&details=517312.

[25] *Id.*

1,500 or fewer employees.[26] U.S. Census Bureau data for 2017 show that there were 2,893 firms in this industry that operated for the entire year.[27] Of that number, 2,837 firms employed fewer than 250 employees.[28] 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.[29] Of these providers, the Commission estimates that 511 providers have 1,500 or fewer employees.[30] Consequently, using the SBA's small business size standard, most of these providers can be considered small entities.

10. *Fixed Microwave Services.* Fixed microwave services include common carrier,[31] private-operational fixed,[32] and broadcast auxiliary radio services.[33] They also include the Upper Microwave Flexible Use Service (UMFUS),[34] Millimeter Wave Service (70/80/90 GHz),[35] Local Multipoint Distribution Service (LMDS),[36] the Digital Electronic Message Service (DEMS),[37] 24 GHz Service,[38] Multiple Address Systems (MAS),[39] and Multichannel Video Distribution and Data Service (MVDDS),[40] where in some bands licensees can choose between common carrier and non-common carrier status.[41] Wireless Telecommunications Carriers (*except* Satellite)[42] 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.[43] U.S. Census Bureau data for 2017

[26] *See* 13 CFR § 121.201, NAICS Code 517312 (as of 10/1/22, NAICS Code 517112).

[27] *See* U.S. Census Bureau, *2017 Economic Census of the United States*, *Employment Size of Firms for the U.S.: 2017*, Table ID: EC1700SIZEEMPFIRM, NAICS Code 517312, .

[28] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[29] Federal-State Joint Board on Universal Service, Universal Service Monitoring Report at 26, Table 1.12 (2022), https://docs.fcc.gov/public/attachments/DOC-391070A1.pdf.

[30] *Id.*

[31] *See* 47 CFR Part 101, Subparts C and I.

[32] *See id*. Subparts C and H.

[33] Auxiliary Microwave Service is governed by Part 74 of Title 47 of the Commission's Rules. *See* 47 CFR Part 74. Available to licensees of broadcast stations and to broadcast and cable network entities, broadcast auxiliary microwave stations are used for relaying broadcast television signals from the studio to the transmitter, or between two points such as a main studio and an auxiliary studio. The service also includes mobile TV pickups, which relay signals from a remote location back to the studio.

[34] *See* 47 CFR Part 30.

[35] *See* 47 CFR Part 101, Subpart Q.

[36] *See id.* Subpart L.

[37] *See id.* Subpart G.

[38] *See id.*

[39] *See id.* Subpart O.

[40] *See id.* Subpart P.

[41] *See* 47 CFR §§ 101.533, 101.1017.

[42] *See* U.S. Census Bureau, *2017 NAICS Definition, "517312 Wireless Telecommunications Carriers* (*except Satellite*)," https://www.census.gov/naics/?input=517312&year=2017&details=517312.

[43] *See* 13 CFR § 121.201, NAICS Code 517312 (as of 10/1/22, NAICS Code 517112).

show that there were 2,893 firms that operated in this industry for the entire year.[44] Of this number, 2,837 firms employed fewer than 250 employees.[45] Thus under the SBA size standard, the Commission estimates that a majority of fixed microwave service licensees can be considered small.

11. Additionally, since the Commission does not collect data on the number of employees for licensees providing these services, at this time we are not able to estimate the number of licensees with active licenses that would qualify as small under the SBA's small business size standard.

12. *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."[46] Satellite telecommunications service providers include satellite and earth station operators. The SBA small business size standard for this industry classifies a business with $44 million or less in annual receipts as small.[47] U.S. Census Bureau data for 2017 show that 275 firms in this industry operated for the entire year.[48] Of this number, 242 firms had revenue of less than $25 million.[49] 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.[50] Of these providers, the Commission estimates that approximately 42 providers have 1,500 or fewer employees.[51] Consequently, using the SBA's small business size standard, a little more than half of these providers can be considered small entities.

13. *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.[52] 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.[53] Providers of Internet services (e.g. dial-up ISPs) or Voice over Internet Protocol

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[44] *See* U.S. Census Bureau, *2017 Economic Census of the United States*, *Employment Size of Firms for the U.S.: 2017*, Table ID: EC1700SIZEEMPFIRM, NAICS Code 517312, https://data.census.gov/cedsci/table?y=2017&n=517312&tid=ECNSIZE2017.EC1700SIZEEMPFIRM&hidePreview=false.

[45] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

[46] *See* U.S. Census Bureau, *2017 NAICS Definition, "517410 Satellite Telecommunications,"* https://www.census.gov/naics/?input=517410&year=2017&details=517410.

[47] *See* 13 CFR § 121.201, NAICS Code 517410.

[48] *See* U.S. Census Bureau, *2017 Economic Census of the United States*, *Selected Sectors: Sales, Value of Shipments, or Revenue Size of Firms for the U.S.: 2017*, Table ID: EC1700SIZEREVFIRM, NAICS Code 517410, https://data.census.gov/cedsci/table?y=2017&n=517410&tid=ECNSIZE2017.EC1700SIZEREVFIRM&hidePreview=false. At this time, the 2022 Economic Census data is not available.

[49] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard. We also note that according to the U.S. Census Bureau glossary, the terms receipts and revenues are used interchangeably, *see* https://www.census.gov/glossary/#term_ReceiptsRevenueServices.

[50] Federal-State Joint Board on Universal Service, Universal Service Monitoring Report at 26, Table 1.12 (2022), https://docs.fcc.gov/public/attachments/DOC-391070A1.pdf.

[51] *Id.*

[52] *See* U.S. Census Bureau, *2017 NAICS Definition*, "*517919 All Other Telecommunications*," https://www.census.gov/naics/?input=517919&year=2017&details=517919.

[53] *Id.*

(VoIP) services, via client-supplied telecommunications connections are also included in this industry.[54] The SBA small business size standard for this industry classifies firms with annual receipts of $40 million or less as small.[55] U.S. Census Bureau data for 2017 show that there were 1,079 firms in this industry that operated for the entire year.[56] Of those firms, 1,039 had revenue of less than $25 million.[57] Based on this data, the Commission estimates that the majority of "All Other Telecommunications" firms can be considered small.

14. *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.[58] 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.[59] The SBA small business size standard for this industry classifies businesses having 1,250 employees or less as small.[60] U.S. Census Bureau data for 2017 show that there were 656 firms in this industry that operated for the entire year.[61] Of this number, 624 firms had fewer than 250 employees.[62] 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

15. The *Report and Order* expands the compliance obligations of Resolution 750's emissions limits to all mobile operations in the 24 GHz band. However, the adoption of the Resolution 750 emissions limits, emissions limits measurement methodology and emissions limits effective date timetables will not impose any new reporting or recordkeeping requirements on small or other entities. No comments were filed in this proceeding regarding the specific implications of our proposals, including any associated costs, on small entities. In assessing the cost of compliance for small entities, at this time the Commission is not in a position to determine whether these actions will require small entities to hire professionals to comply, and cannot quantify the cost of compliance with the rule changes that were

[54] *Id.*

[55] *See* 13 CFR § 121.201, NAICS Code 517919 (as of 10/1/22, NAICS Code 517810).

[56] *See* U.S. Census Bureau, *2017 Economic Census of the United States*, *Selected Sectors: Sales, Value of Shipments, or Revenue Size of Firms for the U.S.: 2017*, Table ID: EC1700SIZEREVFIRM, NAICS Code 517919, https://data.census.gov/cedsci/table?y=2017&n=517919&tid=ECNSIZE2017.EC1700SIZEREVFIRM&hidePreview=false. At this time, the 2022 Economic Census data is not available.

[57] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard. We also note that according to the U.S. Census Bureau glossary, the terms receipts and revenues are used interchangeably, *see* https://www.census.gov/glossary/#term_ReceiptsRevenueServices.

[58] *See* U.S. Census Bureau, *2017 NAICS Definition, "334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing*," https://www.census.gov/naics/?input=334220&year=2017&details=334220.

[59] *Id.*

[60] *See* 13 CFR § 121.201, NAICS Code 334220.

[61] *See* U.S. Census Bureau, *2017 Economic Census of the United States*, *Employment Size of Firms for the U.S.: 2017*, Table ID: EC1700SIZEEMPFIRM, NAICS Code 334220, https://data.census.gov/cedsci/table?y=2017&n=334220&tid=ECNSIZE2017.EC1700SIZEEMPFIRM&hidePreview=false. At this time, the 2022 Economic Census data is not available. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/31SG2//naics~334220

[62] *Id.* The available U.S. Census Bureau data does not provide a more precise estimate of the number of firms that meet the SBA size standard.

adopted. We note, as we did in the IRFA addressing the proposal, that comments in response to the *Public Notice*[63] that raised concerns about increased costs if Resolution 750 emissions limits are adopted, have been taken into consideration.

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

16. 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."[64]

17. In making its determinations regarding the rules adopted in the *Report and Order*, the Commission has sought data on the costs and economic impact of the proposals and approaches discussed in the *Notice* in order to allow the Commission to better evaluate options and alternatives for minimization of any significant economic impact on small entities if Resolution 750 emissions limits and effective date timetables were adopted.

18. Based on the record in this proceeding, our adoption of Resolution 750 emissions limits strives to strike the appropriate balance between protecting passive sensing satellite operations and facilitating use of the 24 GHz band. For example, in the *Report and Order*, the Commission considered, but ultimately declined to adopt rules accelerating the deadline for equipment certification of Phase 1 equipment. In taking that step, the Commission minimized significant economic and administrative burdens on small equipment manufacturers and carriers seeking to plan their own affairs. Additionally, the Commission could have developed and adopted its own emissions limits and related requirements which may have included emissions limits that were more or less strict than the Resolution 750 emissions limits. The Commission could have also simply maintained the existing rules. However, all commenters - including the weather community, scientific community, mobile operators, equipment manufacturers, federal agencies, and other commentors, some of which are small entities - agreed that the Commission should align its rules with Resolution 750 to protect extremely sensitive passive satellite operations, facilitate the continued development and deployment of 5G in the U.S., promote international harmonization, enable equipment manufacturers to provide globally marketable equipment, and to be consistent with U.S. policy relating to Radio Regulations.[65] Thus, the synchronicity between the Resolution 750 emissions limits and the Commission's part 30 rules appears to be the best course of action, although small entities that hold licenses subject to these rules may incur increased deployment costs to comply with the more stringent Resolution 750 emissions limits.

19. In the alternative, if the Commission were to propose and adopt its own emissions limits, particularly if the emissions limits were stricter than both the existing emissions limits and Resolution 750 emissions limits, small entities could be subjected to significantly increased compliance costs without any of the above-mentioned benefits. Further, if the Commission were to propose and adopt less stringent emissions limit requirements or if we simply maintained the existing requirements, our rules may not provide the necessary protections for passive satellite operations to operate in the 24 GHz band and might make it difficult for EESS to make observations free from harmful interference, thereby jeopardizing the accuracy of critical weather forecasting and climatology data. Instead, the Commission believes adoption of the Resolution 750 emissions limits, which were carefully considered and the product of extensive

[63] *See Office of Engineering & Technology and the Wireless Telecommunications Bureau Seek Comment on Emission Limits for the 24.25-27.5 GHz Band*, ET Docket No. 21-186; GN Docket No. 14-177, Public Notice, 36 FCC Rcd 7561 (OET WTB 2021) (*Public Notice*).

[64] 5 U.S.C. § 604(a)(6).

[65] *See Report and Order* at n.33.

industry collaboration, is the right approach and any potential burdens are outweighed by the benefits of protecting passive observations in the 23.6-24.0 GHz band, including improvements in weather forecasting.

20. We received several comments regarding applying the emissions limits to indoor small cell operations. CTIA noted that doing so would impose significant regulatory costs on manufacturers to obtain equipment certification and could delay deployment, without conferring additional benefit to EESS.[66] Ericsson explained that "[t]he Resolution 750 limits are not necessary to protect adjacent services from indoor small cell systems and applying them would only add production costs that hinder the deployment of small cell systems in the band."[67] As discussed in the *Report and Order*, the Commission found that the record was insufficient to support exempting indoor base stations, and decided to apply the Resolution 750 limits to indoor small-cell mobile equipment. While commenters noted that doing so would be unnecessary to reduce the risk of interference and may be costly – commenters did not include specifics, figures, or examples in their filings. As the Commission noted, while an argument could be made for exempting indoor base stations, doing so would require further record development on an appropriate power level for indoor base stations. On the current record, it is unclear to what extent exempting indoor base stations from the Resolution 750 limits would be useful or what sort of cost alleviation – if any – may occur.

21. We also received comments regarding implementation timeline and requirements. AT&T and Qualcomm noted that an accelerated timeline would be "impractical and costly," for stakeholders.[68] For this reason and others discussed in the *Report and Order*, the Commission adopted the Resolution 750 unwanted emissions limits on the timeframes adopted at WRC-19. The first phase limits (–33 dBW for base stations, –29 dBW for mobile stations) will apply as of the effective date of the rules, and the second phase limits (–39 dBW for base stations, –35 dBW for mobile stations) will apply to all deployments after September 1, 2027.

22. AT&T further stated that requiring 24 GHz licensees to replace existing equipment before they intend to place Phase 2 equipment into service would be costly and inefficient, which would discourage deployments before the Phase 2 compliance date.[69] As discussed, to the extent that equipment meeting only the Phase 1 emissions limit is installed sometime on or prior to September 1, 2027, the Commission adopted NTIA's proposal that it "require base station and user equipment modified or replaced after September 2027 to comply with the post-September 2027 emissions limits."[70] But due to cost and inefficiency concerns expressed, the Commission added the clarification that only equipment that undergoes replacement, or modifications that change the emission characteristics of the equipment would constitute a "modification or replacement" triggering the requirement that this equipment must be Phase 2 compliant.

G. Report to Congress

23. The Commission will send a copy of the *Report and Order*, including this FRFA, in a report to Congress pursuant to the Congressional Review Act.[71] In addition, the Commission will send a copy of the *Report and Order*, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A

[66] CTIA Reply Comments at 7.

[67] AT&T Reply Comments at 6; Ericsson Comments at 4; T-Mobile Comments at 7; CTIA Comments at 4. *See also* Qualcomm Comments at 2-3.

[68] AT&T Reply Comments at 5; Qualcomm Comments at 2.

[69] AT&T Reply Comments at 6.

[70] NTIA Comments at 4.

[71] 5 U.S.C. § 801(a)(1)(A).

copy of the *Report and Order*, and FRFA (or summaries thereof) will also be published in the Federal Register.[72]

[72] *Id*. § 604(b).

APPENDIX C

List of Commenters to *Notice of Proposed Rulemaking*

Comments

Michael Ravnitzky
IEEE Geoscience and Remote Sensing Society (IEEE GRSS)
The National Academy of Sciences, through its Committee on Radio Frequencies (CORF)
GuRu Wireless
AT&T Services Inc. (AT&T)
CTIA
T-Mobile USA, Inc. (T-Mobile)
Ericsson
Qualcomm Incorporated (Qualcomm)
National Telecommunications and Information Administration (NTIA)
National Aeronautics and Space Administration (NASA)
National Oceanic and Atmospheric Administration (NOAA)
Wireless Interdisciplinary Research Group (WIRG)
American Geophysical Union, American Meteorological Society, and National Weather Association (AGU/AMS/NWA)

Reply Comments

T-Mobile
Nokia
AT&T
CTIA

Ex Parte

WIRG