

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

In the Matter of)	
)	
Proposed Changes in the Commission's Rules)	ET Docket No. 03-137
Regarding Human Exposure to Radiofrequency)	(Terminated)
Electromagnetic Fields)	
)	
Reassessment of Federal Communications)	ET Docket No. 13-84
Commission Radiofrequency Exposure Limits and)	(Terminated)
Policies)	
)	
Targeted Changes to the Commission's Rules)	ET Docket No. 19-226
Regarding Human Exposure to Radiofrequency)	
Electromagnetic Fields)	

**RESOLUTION OF NOTICE OF INQUIRY, SECOND REPORT AND ORDER, NOTICE OF
PROPOSED RULEMAKING, AND MEMORANDUM OPINION AND ORDER**

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By the Commission: Commissioner Rosenworcel concurring.

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I. INTRODUCTION

1. Modern communications technologies are an ever-increasingly critical part of our everyday lives and play a vital role in the execution of our businesses and daily affairs. The number and types of radiofrequency (RF) devices have proliferated, and the ways we interact with them are continuously changing. As a result, our environment is populated with RF sources, at times located in close proximity to humans. The National Environmental Policy Act of 1969 (NEPA) requires the Commission to evaluate the effects of our actions on the quality of the human environment, including human exposure to RF energy emitted by Commission-regulated transmitters and facilities.¹ The Commission has accordingly promulgated rules that set limits for RF exposure and, through the years, has created a framework to ensure compliance with these limits. Today, we take a number of steps regarding these limits to ensure the health and safety of workers and consumers of wireless technology, while also clarifying and streamlining rules to reduce regulatory burdens on licensees.

2. First, we resolve a *Notice of Inquiry* that sought public input on, among other issues, whether the Commission should amend its existing RF emission exposure limits.² After reviewing the extensive record submitted in response to that inquiry, we find no appropriate basis for and thus decline to propose amendments to our existing limits at this time. We take to heart the findings of the Food & Drug Administration (FDA), an expert agency regarding the health impacts of consumer products, that “[t]he weight of scientific evidence has not linked cell phones with any health problems.”³ Despite requests

¹ National Environmental Policy Act of 1969, as amended, (NEPA) 42 U.S.C. §§ 4321-4335; *Proposed Changes in the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields*, ET Docket No. 03-137, *First Report and Order, Further Notice of Proposed Rulemaking, and Notice of Inquiry*, 28 FCC Rcd 3498, 3503, para. 10 (2013) (hereinafter *2013 RF Order and Notice*); see also 47 CFR § 1.1307(b).

² See generally *infra* Section III.

³ U.S. Food and Drug Administration, Do cell phones pose a health hazard?, <https://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/CellPhones/ucm116282.htm> (last updated Dec. 4, 2017).

from some to increase and others to decrease the existing limits, we believe they reflect the best available information concerning safe levels of RF exposure for workers and members of the general public, including inputs from our sister federal agencies charged with regulating safety and health and from well-established international standards.

3. Second, based on our existing limits, we revise our implementing rules to reflect modern technology and today's uses. We streamline our criteria for determining when a licensee is exempt from our RF exposure evaluation criteria, replacing our prior regime of service-based exemptions with a set of formulas for situations in which the risk of excessive RF exposure is minimal. For those licensees who do not qualify for an exemption, we provide more flexibility for licensees to establish compliance with our RF exposure limits. And we specify methods that RF equipment operators can use to mitigate the risk of excess exposure, both to members of the public and trained workers (such as training, supervision, and signage).

4. Third, we notice further targeted proposals on the application of our RF emission exposure limits for future uses of wireless technologies. Specifically, we propose to formalize an additional limit for localized RF exposure and the associated methodology for compliance for portable devices operating at high frequencies (gigahertz (GHz) frequencies). on top of our already existing limits that apply at these frequencies, and propose to extend this to terahertz (THz) frequencies as well⁴ We also propose to allow wireless power transfer (WPT) equipment under Parts 15 and 18 of the Commission's rules and propose specific exposure limits for such operations.

5. Fourth, and finally, we deny a pending petition for reconsideration and affirm our prior finding that the pinnae (outer ears) should be treated like other extremities for purposes of determining compliance with our RF emission exposure limits.

II. BACKGROUND

6. The Commission has the responsibility to set standards for RF emissions.⁵ The Commission has exercised that responsibility previously on multiple occasions. In a *Report and Order* adopted in 1996, the Commission last established a set of guidelines for evaluating the environmental effects of RF exposure.⁶ These guidelines remain in effect today and include limits for specific

⁴ The standards for localized specific absorption rate (SAR) that are normally applied for testing compliance of consumer devices operating below 6 GHz were derived from the Maximum Permissible Exposure (MPE) whole body limits that extend up to 100 GHz. The Commission currently employs a similar derivation to apply localized limits where appropriate for testing consumer devices operating above 6 GHz, and we propose in this item to formalize that approach.

⁵ NEPA, 42 U.S.C. §§ 4321-4335. The Commission's authority to adopt and enforce RF exposure limits pursuant to the Communications Act and consistent with NEPA is well established. *See, e.g.*, Telecommunications Act of 1996, Pub. L. No. 104-104, § 704(b), 101 Stat. 56, 152 (directing Commission to "prescribe and make effective rules regarding the environmental effects of radio frequency emissions"); 47 U.S.C. § 332(c)(7)(B)(iv) (recognizing Commission's predominant role in regulating RF emissions by proscribing state and local regulation of placement, construction, and modification of FCC-compliant personal wireless service facilities based on environmental effects of such RF emissions). *See also Robbins v. New Cingular Wireless LLC*, 854 F.3d 315, 319-20 (6th Cir. 2017) ("By delegating the task of setting RF-emissions levels to the FCC, Congress authorized the federal government—and not local governments—to strike the proper balance between protecting the public from RF-emissions exposure and promoting a robust telecommunications infrastructure."); *Farina v. Nokia, Inc.*, 625 F.3d 97 (3d Cir. 2010) (FCC regulation of health effects of cell phone RF emissions preempted state lawsuit alleging adverse health effects from FCC-compliant cell phone RF emissions); *Cellular Phone Taskforce v. FCC*, 205 F.3d 82 (2d Cir. 2000) (Commission complied with NEPA in adopting RF emissions safety rules and properly preempted state or local regulation of RF emissions).

⁶ *Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, ET Docket No. 93-62, *Report and Order*, 11 FCC Rcd 15123 (1996) (1996 Order). The Commission affirmed the 1996 Order in its *Second Memorandum Opinion and Order. Guidelines for Evaluating the Environmental Effects of Radiofrequency*

(continued....)

absorption rate (SAR, the present metric for highly-localized, close-in exposure at commonly-used frequencies) and maximum permissible exposure (MPE, the measure for more-distant, whole-body exposure and for whole-body exposure at higher frequencies).⁷ The use of separate SAR and MPE standards, taken together, addresses limits for partial-body and whole-body exposures.⁸ In promulgating these guidelines, the Commission recognized that the potential for environmental impact from excluded devices was not significant,⁹ and established exemptions¹⁰ from the obligation to perform routine RF exposure evaluation for radio stations and existing facilities with technical characteristics that minimized, at that time, the likelihood of exceeding our limits.¹¹ The various exemptions were established over time based on assumptions about typical use particular to each service.¹²

7. In 2003, the Commission sought comment on exempting some transmitting antennas and devices from routine environmental evaluation for RF compliance and proposed to clarify the

(Continued from previous page)

Radiation et al., ET Docket Nos. 93-62 et al, Second Memorandum Opinion and Order and Notice of Proposed Rule Making, 12 FCC Rcd 13494 (1997) (*Second Memorandum Opinion and Order*).

⁷ The guidelines were based on criteria published by the National Council on Radiation Protection and Measurements (NCRP) and the American National Standards Institute/Institute of Electrical and Electronics Engineers, Inc. (ANSI/IEEE). The National Council on Radiation Protection and Measurements (NCRP), Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields, NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2, 17.4.3 and 17.4.5 (1986) (NCRP Report No. 86). The NCRP is a nonprofit corporation chartered by Congress in 1964 primarily to collect, analyze, develop, and disseminate information on radiation protection. The American National Standards Institute (ANSI), IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, ANSI/IEEE Std C95.1-1992, Sections 4.1 and 4.2 (copyright IEEE 1992). The content of IEEE C95.1-1991 is equivalent to that of ANSI/IEEE C95.1-1992. IEEE is a non-profit international professional association of electrical and electronics engineers involved in technology standards development. ANSI is a private, not-for-profit organization that facilitates standards development.

⁸ See 1996 Order, 11 FCC Rcd at 15123, para. 2 & n.3.

⁹ See 47 CFR § 1.1306. See also *Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, ET Docket No. 93-62, Notice of Proposed Rulemaking, 8 FCC Rcd 2849, para. 5 (1993).

¹⁰ As discussed in the 2013 RF Order and Notice, and to avoid confusion in the NEPA context, we will use the term “exemption” (rather than “exclusion” or “categorical exclusion”) to refer to an exemption from the obligation to perform an RF exposure routine evaluation. 2013 RF Order and Notice, 28 FCC Rcd at 3534-35, para. 113. By contrast, under NEPA and the Commission’s environmental rules, the term “categorical exclusion” refers to an exclusion of categories of actions from obligations to prepare an environmental assessment or other environmental evaluation. See 40 CFR § 1508.4; 47 CFR § 1.1306(a). The Commission’s categorical exclusions for actions that have no potentially significant environmental impact do not apply to actions that have specified impacts on certain natural resources or actions that result in human exposure to RF radiation in excess of applicable safety standards. See 47 CFR §§ 1.1306(b), 1.1307(a) & (b).

¹¹ These exemptions were modified in the 1997 *Second Memorandum Opinion and Order*, 12 FCC Rcd at 13509, para. 40. The Commission concluded that for mobile devices operating above 1.5 GHz with an effective radiated power of less than 3 watts, in addition to a similar provision for mobile devices operating below 1.5 GHz with an effective radiated power of less than 1.5 watts, the likelihood of exceeding established RF exposure limits was minimal. See *Second Memorandum Opinion and Order*, ET Docket 93-62, released August 25, 1997, FCC 97-303, 12 FCC Rcd at 13494 (1997).

¹² See, e.g., any item generally that introduces a new rule part or service, such as *Use of Spectrum Bands above 24 GHz for Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8192, Appx. A (2016) (2016 Spectrum Frontiers R&O and Further Notice) or *Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, 30 FCC Rcd 3959, 4095, Appx. A. In each case, 47 CFR § 1.1307 was amended to include exemptions for each new service.

responsibilities of licensees and grantees and make the exemptions more practical, consistent, and efficient.¹³ To this end, the Commission made several proposals related to compliance with the human exposure limits for fixed, mobile, and portable transmitters.¹⁴ In 2013, the Commission addressed several of those proposals; specifically, it clarified procedures for evaluating whether a particular RF source would exceed the established exposure limits.¹⁵ The Commission also clarified references used to determine compliance with its limits, including making explicit that SAR limits predominate MPE limits as a compliance metric (although MPE limits are practical and may still be used as an alternative to demonstrate compliance in most cases), as well as treating the pinnae (outer ears) similarly to extremities of the body for purposes of determining exposure limits.¹⁶

8. In a 2013 Further Notice of Proposed Rulemaking, the Commission sought additional comment on changes to the compliance procedures to provide more efficient, practical, and consistent application of evaluation procedures and mitigation measures.¹⁷ The Commission proposed to define certain key terms and broadly revise and harmonize the criteria for determining whether single or multiple portable, mobile, or fixed RF sources¹⁸ are subject to routine evaluation for compliance with the RF exposure limits or are exempted from such evaluations.¹⁹ Additionally, the Commission proposed clarifications of evaluation requirements for portable and medical implant devices.²⁰ Further, the Commission proposed to adopt new requirements for signs and barriers at fixed transmitter sites.²¹ The Commission also proposed a clarification of the definition of and requirements for “transient exposure” to better ensure compliance with exposure limits.²² It also sought comment on establishing and clarifying who should bear responsibility for compliance with the RF emissions exposure requirements.²³

9. In 2013, the Commission inquired whether it should reevaluate its RF exposure limits and policies in light of recent scientific opinions, authoritative expert views, changes in RF devices, and/or the prevalence and usage patterns of RF devices.²⁴ In particular, the Commission asked whether these considerations warrant changes in the basic RF exposure limits, the RF evaluation procedures for devices, or the content and manner in which information regarding RF exposure by FCC-regulated devices are conveyed to the public.²⁵

¹³ *Proposed Changes in the Commission’s Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields*, ET Docket No. 03-137, Notice of Proposed Rule Making, 18 FCC Rcd 13187 (2003) (*2003 RF NPRM*).

¹⁴ *Id.* at 13189-206, paras. 6-49.

¹⁵ *See 2013 RF Order and Notice*, 28 FCC Rcd at 3500, para. 1.

¹⁶ *See id.* at 3505 *et. seq.*, paras. 14-107. As extremities, the pinnae – along with the hands, wrists, feet, and ankles – is subject to less stringent localized RF exposure limits than the rest of the body. *See id.* at 3514, paras. 42-50.

¹⁷ *2013 RF Order and Notice*, 28 FCC Rcd at 3533, paras. 108-09.

¹⁸ RF source is a more general term than transmitter or transmitting antenna and applies to Commission-regulated equipment and devices that may not be intentional transmitters but radiate RF energy. *See generally 2013 RF Order and Notice*, 28 FCC Rcd at 3549, *et. seq.*

¹⁹ *See 2013 RF Order and Notice*, 28 FCC Rcd at 3535, para. 114.

²⁰ *Id.* at 3555, para. 168.

²¹ *Id.* at 3560, para. 184.

²² *Id.* at 3557, para. 177.

²³ *Id.* at 3564, para. 193, at 3567-68, paras. 198, 199.

²⁴ *Id.* at 3570, para. 205-52.

²⁵ *Id.* at 3570, para. 205.

III. RESOLUTION OF NOTICE OF INQUIRY

10. We resolve and terminate the inquiry to review our RF exposure standards and certain related policies initiated in the *2013 RF Order and Notice*.²⁶ In the proceeding, the Commission solicited comment on a variety of issues, including RF exposure limits, consumer information, exposure reduction policies, emissions exposure evaluation, and proximity restrictions and disclosure requirements for portable RF sources.²⁷ Upon review of the record, we find no appropriate basis for and thus decline to initiate a rulemaking to reevaluate the existing RF exposure limits. This decision is supported by our expert sister agencies, and the lack of data in the record to support modifying our existing exposure limits. Specifically, no expert health agency expressed concern about the Commission's RF exposure limits. Rather, agencies' public statements continue to support the current limits. The Director of FDA's Center for Devices and Radiological Health advised the Commission, as recently as April 2019, that "no changes to the current standards are warranted at this time."²⁸ The record does not demonstrate that the science underpinning the current RF exposure limits is outdated or insufficient to protect human safety. Nor does the record include actionable alternatives or modifications to the current RF limits supported by scientifically rigorous data or analysis. For all these reasons, we terminate the inquiry, but will continue to study and review publicly available science and collaborate with other federal agencies and the international community to ensure our limits continue to reflect the latest science. If an appropriate basis for launching a new Commission proceeding arises, we are confident that the Commission will undertake further evaluation of our rules in light of that review.

11. Our existing exposure limits were adopted following recommendations from the U.S. Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and other federal health and safety agencies.²⁹ While research on the health effects of RF energy continues,³⁰ no evidence has moved our sister health and safety agencies to issue substantive policy recommendations for strengthening RF exposure regulation. Indeed, the FDA maintains that "[t]he weight of scientific

²⁶ See ET Docket No. 13-84.

²⁷ *2013 RF Order and Notice*, 28 FCC Rcd at 3574-89, paras. 216-52.

²⁸ See Letter from Jeffrey Shuren, M.D., J.D., Director, Center for Devices and Radiological Health, Food and Drug Administration, Department of Health and Human Services, to Julius Knapp, FCC, (dated April 24, 2019) (*FDA Letter*) at 2.

²⁹ *2013 RF Order and Notice*, 28 FCC Rcd at 3570, para. 205; *1996 Order*, 11 FCC Rcd at 15124, para 2.

³⁰ Since the release of the *2013 RF Order and Notice*, the World Health Organization (WHO) is in the process of revising its Environmental Health Criteria (EHC) on radiofrequency electromagnetic fields. The EHC summarizes the review of a panel of expert scientists concerning the physical characteristics of electromagnetic fields, as well as "measurement techniques, applications of electromagnetic fields and sources of exposure, mechanisms of interaction, biological effects, and guidance on the development of protective measures, such as regulations or safe-use guidelines," and it will be used as input by international standards bodies in their development of future guidelines limiting human exposure to radiofrequency energy. See http://www.who.int/peh-emf/research/rf_ehc_page/en/ ("The World Health Organization is undertaking a health risk assessment of radiofrequency electromagnetic fields, to be published as a monograph in the Environmental Health Criteria Series. This publication will complement the monographs on static fields (2006) and extremely low frequency fields (2007) and will update the monograph on radiofrequency fields (1993)."); see also 1993 WHO EHC 137 on RF-EMF (ISBN 92-4-157137-3), available at <http://www.inchem.org/documents/ehc/ehc/ehc137.htm>; National Toxicology Program, *Cell Phone Radiation Studies*, available at https://www.niehs.nih.gov/health/materials/cell_phone_radiofrequency_radiation_studies_508.pdf (NTP is collaborating with NIST and IT'IS to develop additional short-term measurement techniques and studies to investigate so that future shorter term studies can be conducted to evaluate different RFR frequencies and modulations reflecting the changing technologies in the telecommunications industry.) (Nov. 2018).

evidence has not linked cell phones with any health problems”³¹ and that “the current safety limits for cell phones are acceptable for protecting the public health.”³² Accordingly, it is imprudent to revise these scientifically accepted recommendations without appropriate evidence supporting such a change,³³ especially when the FDA itself has found no evidence to support any revisions.³⁴ We take our duty to protect the public from any potential harm due to RF exposure seriously. Indeed, as noted in the inquiry,

³¹ U.S. Food and Drug Administration, Do cell phones pose a health hazard? (“The weight of scientific evidence has not linked cell phones with any health problems.”), <https://www.fda.gov/radiation-emitting-products/cell-phones/health-issues> (last updated Dec. 4, 2017).

³² *Statement from Jeffrey Shuren, M.D., J.D., director of the FDA’s Center for Devices and Radiological Health on the recent National Toxicology Program draft report on radiofrequency energy exposure* (Feb. 2, 2018), <https://www.fda.gov/news-events/press-announcements/statement-jeffrey-shuren-md-jd-director-fdas-center-devices-and-radiological-health-recent-national>.

³³ The National Toxicology Program (NTP) of the U.S. Department of Health and Human Services has released final reports of its findings, stating that its study found increases in the incidences of malignant schwannoma in the hearts of male rats exposed to cell phone radiation. <https://ntp.niehs.nih.gov/results/areas/cellphones/index.html> (last updated May 7, 2019) (NTP Animal Studies). Another animal study was conducted by the Ramazzini Institute published in *Environmental Research* reporting results of research involving 1.8 GHz RF exposure in rats, in *Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission*, 165 *Environmental Research* 496-503 (pub. Aug. 2018), available at <https://www.sciencedirect.com/science/article/pii/S0013935118300367> (Ramazzini Study). NTP has not suggested in its findings what this research may mean relative to human beings, including anything that would help to indicate appropriate exposure levels, and its research work is ongoing at this time. In particular, John Bucher, an NTP senior scientist, stated that “[t]he exposures used in the studies cannot be compared directly to the exposure that humans experience when using a cell phone.” National Institute of Environmental Health Sciences, High Exposure to Radio Frequency Radiation Associated with Cancer in Male Rats (Nov. 1, 2018). Dr. Bucher suggested that the results cannot be extrapolated to humans because (1) the rats and mice received RF radiation across their whole bodies; (2) the exposure levels were higher than what people receive under the current rules; (3) the duration of exposure was longer than what people receive; and (4) the studies were based on 2G and 3G phones and did not study WiFi or 5G. <https://www.niehs.nih.gov/news/newsroom/releases/2018/november1/index.cfm> (November 1, 2018). Additionally, FDA officials reviewing this research also note that “based on our ongoing evaluation of this issue and taking into account all available scientific evidence we have received, we have not found sufficient evidence that there are adverse health effects in humans caused by exposures at or under the current radiofrequency energy exposure limits.” See *Statement from Jeffrey Shuren, M.D., J.D., director of the FDA’s Center for Devices and Radiological Health on the recent National Toxicology Program draft report on radiofrequency energy exposure* (Feb. 2, 2018), <https://www.fda.gov/news-events/press-announcements/statement-jeffrey-shuren-md-jd-director-fdas-center-devices-and-radiological-health-recent-national>; *id.* (“Even with frequent daily use by the vast majority of adults, we have not seen an increase in events like brain tumors. Based on this current information, we believe the current safety limits for cell phones are acceptable for protecting the public health.”).

³⁴ See Letter from Jeffrey Shuren, M.D., J.D., Director, Center for Devices and Radiological Health, Food and Drug Administration, Department of Health and Human Services, to Julius Knapp, FCC, (dated April 24, 2019) (*FDA Letter*) at 2 (“NTP’s experimental findings should not be applied to human cell phone usage, the available scientific evidence to date does not support adverse health effects in humans due to exposures at or under the current limits, and the FDA is committed to protecting public health and continues its review of the many sources of scientific literature on this topic.”). ICNIRP discussing both the NTP Animal Studies and the Ramazzini Study concluded that “these studies do not provide a reliable basis for revising the existing radiofrequency exposure guidelines” and noted various inconsistencies, limitations, and further need to review the application of animal studies to human carcinogenicity research that affect the usefulness of the studies in setting exposure guidelines. International Commission on Non-Ionizing Radiation Protection, *ICNIRP Note on Recent Animal Carcinogenesis Studies*, Munich, Germany (Apr. 9, 2018), <https://www.icnirp.org/cms/upload/publications/ICNIRPnote2018.pdf> (summarizing the studies and providing initial conclusions).

our limits for devices held close to the body are more restrictive than other more recently published international limits.³⁵

12. In the inquiry, we sought comment to determine whether our general rules and regulations limiting RF exposure are still appropriately drawn.³⁶ Over 1,000 comments or ex parte presentations were filed in the proceeding. The vast majority of filings were unscientific, and even the filings that sought to present scientific evidence failed to make a persuasive case for revisiting our existing RF limits. While the record includes some research information, there is no persuasive case in the record to evaluate the quality and significance of that research. Nor do cases advocating alternatives in the record provide sufficient scientific evidence or explanation justifying why the proposed reductions are the appropriate value(s), or how they might affect the viability or performance of wireless services and devices. In other words, while the record includes scientific papers of variable quality and significance that allude to more restrictive RF exposure limits under certain circumstances, they fail to provide any specific, pragmatic recommendation for how our RF exposure limits could be adjusted as a result of this research.³⁷ The *Inquiry* requested comment on whether any general technical approach to reduce exposure below our limits in some situations is appropriate or feasible, particularly in cases in which there is no specific quantitative goal for improvement.³⁸ Commenters that provided scientific articles did not answer our request for a specific, quantitative goal but many provided descriptive references to the BioInitiative Report and Building Biology, which specify extremely low limits (0.3-0.6 nW/m² and 0.1 μW/m², respectively) for RF energy exposure—limits that are millions to billions times more restrictive than FCC limits.³⁹ No device could reliably transmit any usable level of energy by today's technological standards while meeting those limits.⁴⁰ Further, there is no scientific evidence in the record that such restrictive limits would produce any tangible benefit to human health, or provide any improvement over current protections against established risks.⁴¹ Moreover as noted by the FDA, there is no evidence to support that adverse health effects in humans are caused by exposures at, under, or even in

³⁵ See 2013 RF Order and Notice, 28 FCC Rcd at 3572-73, 3575-76, paras. 213, 220. IEEE Std C95.1-2005 and the ICNIRP HF Guidelines establish localized SAR limits of 2.0 W/kg averaged over 10 grams of tissue as opposed to our existing localized SAR limit of 1.6 W/kg averaged over 1 gram. *Id.* at 3573, para. 213. Applying this approach, a larger averaging volume of similar shape would permit a higher spatial peak field in a small area of that mass, as there is more non-peak-exposed mass considered in the averaging. Therefore, based on the application of this approach, the spatial peak exposure in a 10-gram cube as would be measured for compliance in any other more recently adopted international limits is likely more than the spatial peak exposure in a 1-gram cube for the same averaged SAR value specified in our rules.

³⁶ 2013 RF Order and Notice, 28 FCC Rcd at 3570-71, paras. 205-10. We also noted the recommendation of the United States Government Accountability Office (GAO) in a report to Congress that the Commission formally reassess its current RF energy exposure limit, including the effects on human health and that it solicit the opinions of relevant health and safety agencies in deciding whether any change in the current RF energy exposure limit is appropriate. *Id.* at 3570, para. 206 (citing United States Government Accountability Office, Report to Congressional Requesters, *TELECOMMUNICATIONS: Exposure and Testing for Mobile Phones Should Be Reassessed*, GAO-12-771 (July 2012)).

³⁷ *Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, Second Memorandum Opinion and Order and Notice of Proposed Rulemaking, 12 FCC Rcd 13494, 13505, para. 31 (1997).

³⁸ 2013 RF Order and Notice, 28 FCC Rcd at 3583, para. 238.

³⁹ See BioInitiative Working Group, BioInitiative 2012 Report (2012), <https://www.bioinitiative.org/table-of-contents>; BAUBIOLOGIE MAES / Institut für Baubiologie + Ökologie IBN, Standard of Building Biology Testing Methods, SBM-2008 (2008), <https://www.baubiologie.de/downloads/building-biology-guidelines-english.pdf>.

⁴⁰ See MWF Reply at 6 (noting that the BioInitiative Reports' suggested limits would result in compliance zones around base station sites that would extend several kilometers for a macro base station).

⁴¹ 2013 RF Order and Notice, 28 FCC Rcd at 3584, para. 240.

some cases above, the current RF limits.⁴² Indeed, no scientific evidence establishes a causal link between wireless device use and cancer or other illnesses.⁴³

13. While some commenters seek Commission action to tighten RF exposure standards, others suggest that the Commission should revise its RF exposure standards to be consistent with less-restrictive international standards, like the IEEE or the ICNIRP RF standard.⁴⁴ For similar reasons that we decline to make changes that would tighten the current standard, we decline to make any changes that would effectively relax our current standard.⁴⁵ Accordingly, we conclude that the best available evidence, including our consideration of the opinions provided by our expert sister agencies, supports maintaining our current RF exposure standards.

14. We also decline to revisit our RF exposure evaluation procedures for consumer portable devices, especially phones. Current evaluation procedures require consumer portable devices to be tested at maximum power under normal use conditions. For phones testing is performed against the head, representing normal use during a phone call, and at a separation distance of up to 2.5 centimeters (about

⁴² See Statement from Jeffrey Shuren, M.D., J.D., director of the FDA's Center for Devices and Radiological Health on the recent National Toxicology Program draft report on radiofrequency energy exposure (Feb. 2, 2018), <https://www.fda.gov/news-events/press-announcements/statement-jeffrey-shuren-md-jd-director-fdas-center-devices-and-radiological-health-national>; *id.* ("We ... must thoroughly evaluate and take into consideration the totality of the data, and do so within the context of the complete body of evidence rather than drawing conclusions from the results of a single study. As part of our commitment to protecting the public health, the FDA has reviewed, and will continue to review, many sources of scientific and medical evidence related to the possibility of adverse health effects from radiofrequency energy exposure in both humans and animals and will continue to do so as new scientific data are published. Based on our ongoing evaluation of this issue, the totality of the available scientific evidence continues to not support adverse health effects in humans caused by exposures at or under the current radiofrequency energy exposure limits. We believe the existing safety limits for cell phones remain acceptable for protecting the public health.")

⁴³ FCC, Wireless Devices and Health Concerns (Aug. 6, 2018), <https://www.fcc.gov/consumers/guides/wireless-devices-and-health-concerns>.

⁴⁴ Institute of Electrical and Electronics Engineers, Inc. (IEEE Std C95.1-2005), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005, copyright 2006 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, New York 10016-5997; International Commission on Non-Ionizing Radiation Protection (ICNIRP HF Guidelines), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, Health Physics 74 (4): 494-522, 1998. ICNIRP is an international non-profit organization comprised of independent scientific experts that provides scientific advice and guidance on the health and environmental effects of non-ionizing radiation (NIR) to protect people and the environment from detrimental NIR exposure.

⁴⁵ See International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Draft ICNIRP Guidelines, Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (100 kHz TO 300 GHz)*, Appx. A: Review of Studies on Dosimetry, section 3.3.2 ("Spatial averaging considerations") at 10, https://www.icnirp.org/cms/upload/consultation_upload/ICNIRP_RF_Guidelines_PCD_Appx_A_2018_07_11.pdf (July 11, 2018).; See also Institute of Electrical and Electronics Engineers, Inc. (IEEE Std C95.1-2019), *IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz*, IEEE Std C95.1-2019, copyright 2019 by the Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York, New York 10016-5997, https://standards.ieee.org/standard/C95_1-2019.html (October 4, 2019). We observe that this standard is intended for RF protection of military personnel, and while our intent is to protect the broader public, these standards can be illuminating in that regard. See IEEE Std C95.1-2345-2014 - IEEE Standard for Military Workplaces--Force Health Protection Regarding Personnel Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz (May 30, 2014), <http://standards.ieee.org/findstds/standard/C95.1-2345-2014.html>.

one inch) from the body to represent phone use in other ways.⁴⁶ Even though some parties claim that the RF exposure evaluation procedures for phones should require testing with a “zero” spacing – against the body – this is unnecessary. First, phones are tested against the head without any separation distance to represent normal use conditions during a phone call. Second, at maximum power, even though they are not consistently operated at such power levels. This means that testing is performed under more extreme conditions than a user would normally encounter, so any potential dangers at zero-space would be mitigated.⁴⁷ Third, actual testing separation distances tend to be less than the 2.5 cm prescribed for many devices. For example, phones with tethering capabilities (*i.e.*, “hotspot mode”) are tested at a maximum separation distance from the human body of 1 cm.⁴⁸ Fourth, our existing exposure limits are set with a large safety margin, well below the threshold for unacceptable rises in human tissue temperature. Thus, even if certified or otherwise authorized devices produce RF exposure levels in excess of Commission limits under normal use, such exposure would still be well below levels considered to be dangerous, and therefore phones legally sold in the United States pose no health risks.⁴⁹

15. We further decline to revisit our RF exposure policy as it pertains to children. Under IEEE Std 1528-2003—the standard for determining the compliance of devices such as cell phones—the measurement test setup that is used was designed to test for effects on children as well as adults.⁵⁰ Similarly the FDA maintains that “[t]he scientific evidence does not show a danger to any users of cell phones from RF exposure, including children and teenagers.”⁵¹ Since the inquiry, scientific debate has continued about whether either dosimetric (*e.g.*, higher conductivity of skull and brain tissues in children’s heads) or anatomical differences (*e.g.*, characteristically smaller sized heads and outer ears) in children could result in unacceptably high exposures depending on use conditions.⁵² While we agree that there are differences in actual exposure in real human heads,⁵³ and acknowledge that possible age-related

⁴⁶ KDB Publication 447498 D01, “RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices.” See FCC Office of Engineering and Technology, Laboratory Division, Knowledge Database, <https://apps.fcc.gov/oetcf/kdb/>.

⁴⁷ Further, certain manufacturers design their phones to include features like proximity sensors, which reduce power when close to a user’s body, to ensure that they are compliant even if the phones are used in a nonconforming manner, and any potential dangers at zero-space would be detected anyway. Other manufacturers have changed device form factors, including antenna design, to ensure reduced RF exposure to the user. Power control and discontinuous transmission on the devices assures that devices operate well below maximum power for the vast majority of the time, and hence result in lower RF exposure. See Nokia Comments at 17; MWF Comments at 7.

⁴⁸ KDB Publication 941225 D06, “SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities” (Oct. 2015). See FCC Office of Engineering and Technology, Laboratory Division, Knowledge Database, <https://apps.fcc.gov/oetcf/kdb/>.

⁴⁹ We note that any claim as to the adequacy of the FCC required testing, certification, and authorization regime is no different than a challenge to the adequacy of the federal RF exposure limits themselves. Both types of claims would undermine the FCC’s substantive policy determinations.

⁵⁰ See *IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques*, IEEE Std 1528-2003 (the test setup represents a conservative case “for men, women, and children” alike).

⁵¹ See <https://www.fda.gov/radiation-emitting-products/cell-phones/children-and-cell-phones>.

⁵² See, *e.g.*, Foster, K. R. and Chou, C.-K., *Are Children More Exposed to Radio Frequency Energy from Mobile Phones than Adults?*, IEEE Access, vol. 2, pp. 1497-1509, Dec. 2014; Gandhi, O. P., *Yes the Children Are More Exposed to Radiofrequency Energy from Mobile Telephones Than Adults*, IEEE Access, vol. 3, pp. 985-988, June 2015.

⁵³ SAR quantities in actual human heads do not vary as they do in homogeneous liquids that are used for standardized compliance testing, but the properties of those liquids were chosen to conservatively represent the heterogeneous tissues in real human heads, including age variation.

differences in absorption of RF energy in the heads of mobile phone users could result in differences in exposure to the head, these considerations were appropriately taken into account and incorporated into the measurement standards.⁵⁴ Therefore, based on the evidentiary record, we see no reason to revisit our equipment authorization procedures as a result.

16. We also continue to ensure that relevant information is made available to the public. First, the Commission maintains several webpages that provide information about RF exposure to the public. These range from general RF exposure information to information on specific topics, including wireless devices and health concerns.⁵⁵ Second, guidance from the FCC Laboratory continue recommending that device manuals include operating instructions and advisory statements for RF exposure compliance.⁵⁶ This information allows users to make informed decisions on the type of body-worn accessories and operating configurations that are appropriate for their usage. Third, we make available information on the characterization of typical RF exposure levels emitted from base stations. Relatedly, we note that the World Health Organization (WHO) states that “[f]rom all evidence accumulated so far, no adverse short-or long-term health effects have been shown to occur from the RF signals produced by base stations.”⁵⁷ WHO goes on to say that the erroneous public perception of a possible risk from such exposure may, even while unsupported by evidence, still contribute to a feeling of uncertainty or a lack of control. That is why the context and placement of RF exposure information is so important. Given the federal safety determination, the information on the FCC’s websites and in device manuals are both adequate to inform consumers of these issues and do not risk contributing to an erroneous public perception or overwarning of RF emissions from FCC certified or authorized devices. The FCC will continue to evaluate public information materials and update as appropriate.

IV. SECOND REPORT AND ORDER

17. This *Second Report and Order* revises the rules regarding the two methods of complying with our RF exposure limits: *exemption*—consideration of whether a particular device or deployment is so clearly compliant with our rules that it qualifies as exempt from the requirement to undertake a more thorough analysis; and *evaluation*—a more specific examination of an individual site or device, which considers factors beyond those used for exemption for less obvious cases and may be performed with a variety of computation and/or measurement methodologies.⁵⁸ In addition, we discuss *mitigation*—the

⁵⁴ See Beard, B., et al., *Comparisons of Computed Mobile Phone Induced SAR in the SAM Phantom to That in Anatomically Correct Models of the Human Head*, IEEE Trans. on Electromagnetic Compatibility, Vol. 48, No. 2, pp. 397–407 (May 2006). See also Christ, A., et. al., *Age-Dependent Tissue-Specific Exposure of Cell Phone Users*, Phys. Med. Biol., vol. 55, pp. 1767–1783 (Mar. 2010). See also Hadjem A., et. al., *Analysis of Power Absorbed by Children’s Head as a Result of New Usages of Mobile Phones*, IEEE Trans. Electromagnetic Compatibility, Vol. 52, No. 4, pp. 812–819 (Nov. 2010).

⁵⁵ See <https://www.fcc.gov/consumers/guides/wireless-devices-and-health-concerns>. See also <https://www.fda.gov/radiation-emitting-products/cell-phones/reducing-exposure-hands-free-kits-and-other-accessories>.

⁵⁶ The Commission does not endorse the need to take measures to further reduce exposure to RF energy. However, for any consumers who are skeptical of the science and/or the analysis that underlies the Commission’s RF exposure guidelines, the Commission provides information on simple steps that you can take to reduce your exposure to RF energy from wireless phones. See FCC, Consumer and Governmental Affairs Bureau, Wireless Devices and Health Concerns, Consumer Guide, <https://www.fcc.gov/consumers/guides/wireless-devices-and-health-concerns>.

⁵⁷ <https://www.who.int/peh-emf/publications/facts/fs304/en/>

⁵⁸ We reiterate that regardless of whether a site is exempt from RF exposure routine evaluation, licensees are responsible for a device’s or transmitter’s compliance with our RF exposure limits. See 47 CFR § 1.1307(b)(1), (b)(2)(v), (b)(3)(i), (ii). In the event that RF levels would result in human exposure in excess of our limits, a formal Environmental Assessment must be conducted to initiate processing under NEPA to determine whether it presents a (continued....)

measures taken to restrict or limit RF exposure, for example in controlled areas, to keep exposure within our limits. We emphasize that this *Second Report and Order* makes no changes to the existing limits for RF exposure. The new methods that we adopt herein only affect how parties determine and demonstrate that they are in compliance with those standards.

18. The new rules we adopt are consistent with general engineering principles and the exposure limits themselves. The level of exposure is a function of the power and frequency of the RF transmission, a person's distance from the source, and the duration of the exposure. The new rules account for these variables, permitting a more streamlined exemption process in low-exposure situations (low power, relatively large distance between the source and a person's body, and/or short duration), while requiring a more thorough evaluation in potentially higher-exposure situations (higher power, smaller distance between the source and a person's body, and/or longer duration). Our rules also reflect that more restrictive limits are appropriate for the general public than for those persons (typically workers) who are trained to understand the need to limit their exposure and have the knowledge and capability to do so.

19. This *Second Report and Order* proceeds in three parts. First, we address the exemptions from the RF evaluation requirement, identifying broad criteria that apply to single and multiple RF sources based on power, distance, and frequency, irrespective of service classifications. The Office of Engineering and Technology (OET)⁵⁹ will offer more detailed case-specific guidance as needed through the Knowledge Database (KDB), as well as through technical bulletins and supplements, such as OET Bulletin 65.⁶⁰ Second, we clarify the calculation or measurement methodologies that should be used, in cases where no exemption applies, to determine potential RF exposure levels in the RF evaluation process. In the third and final section, we address post-evaluation mitigation procedures, like access, signage, and training, to ensure that persons—both the general public and trained personnel—are not exposed to RF emissions in excess of our established exposure limits. The new rules clarify the obligations of licensees to provide safety training to workers and to supervise any members of the general public (including untrained workers) who are permitted to enter a restricted area.

A. Exemptions from the RF Exposure Evaluation Requirement

20. We adopt the proposals in the *2013 RF Further Notice* to revise the various specific criteria that governed the exemptions from our RF evaluation requirements in favor of a single, generally-

(Continued from previous page) _____

hazard to humans irrespective of its noncompliance with our exposure limits. See 42 U.S.C. §§ 4321-4335. To date, no applicant or licensee has submitted an Environmental Assessment for RF exposure to the Commission.

⁵⁹ OET has developed a substantial body of guidance that is available via public notices, frequently asked questions (FAQs), and specific process guidance, all of which is compiled in our online Knowledge Database (KDB). See FCC Office of Engineering and Technology, Laboratory Division, Knowledge Database, <https://apps.fcc.gov/oetcf/kdb/>. Equipment authorization topics that relate to new services and devices authorized by the Commission are often addressed in the KDB. This includes, for example, simple answers to questions, guidance on how to file for authorization of new types of devices, and guidance on how to conduct compliance testing. The staff guidance provided in the KDB is non-binding and is intended to assist the public in following Commission requirements.

⁶⁰ FCC Office of Engineering and Technology, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, OET Bulletin 65, Edition 97-01 (1997) (OET Bulletin 65). OET Bulletin 65 provides guidance in determining whether proposed or existing transmitting facilities or operations comply with FCC rules limiting human exposure to RF energy. *Id.* at 1. Supplements A and B to OET Bulletin 65 provide specialized guidance for specific services—broadcasting and amateur radio, respectively—in their compliance determinations.

applicable set of formulas for both single and multiple sources of RF emissions based on power, distance, and frequency of fixed, mobile, and portable transmitters.⁶¹

21. The rules we adopt replace a patchwork of outdated and inconsistent rules. Specifically, the old rules are outdated because they were developed before the more recent proliferation of RF sources, particularly fixed RF antennas now commonly found on rooftops, lampposts, and other places not previously used for such applications.⁶² The old rules also are inconsistent because they exempt transmitters from evaluation for compliance with the RF limits depending on the service they offer and certain technical characteristics, typically power and/or height.⁶³ Those rules incorporate various assumptions that result in dissimilar requirements for similar services. For example, a Part 101 transmitter and a Part 30 transmitter both using millimeter wave spectrum, with similar antenna gain and transmitter power, are treated differently under the old rules—while the Part 30 transmitter requires an evaluation, the Part 101 does not.⁶⁴ Further, the old rules treat certain RF transmitters—like ship earth station transmitters under Part 80—as requiring evaluation regardless of technical characteristics,⁶⁵ while there are whole categories of transmitters—like Part 90 transmitters that do not fall under subparts P or S—that are exempt.⁶⁶ As a result, while certain classes of RF transmitters were categorically subject to evaluation, others were not, without a consistent rationale.⁶⁷

22. The new exemption criteria apply to all of our rules authorizing RF sources.⁶⁸ Specifically, we create three broad classes of RF exemptions: (i) for extremely low-power devices that transmit at no more than 1 mW; (ii) for somewhat higher-power devices with transmitting antennas that operate within 40 cm of the body, a formula based primarily on the localized specific absorption rate (SAR) limits; and (iii) for all other transmitters based on a set of formulas for the maximum permissible

⁶¹ See *2013 RF Order and Notice*, 28 FCC Rcd at 3537-38, para. 119. The Commission also proposed using the term “exemption” (as opposed to “exclusion”) for this topic and proposed a set of technical definitions related to output power and separation distance. *Id.* at 3534-35, para. 113. No commenting party opposed the terminology or the definitions and we adopt them as shown in the Final Rules. See *infra* Appx. A. A list of commenters to the *2013 RF Order and Notice* appears in Appx. E.

⁶² See 47 CFR § 1.1307(b)(1), tbl. 1, (b)(2).

⁶³ *Id.* For example, the old rules determined an exemption depending whether a transmitter was above an ERP threshold depending on which service rules applied, and how the transmitter was installed (*e.g.*, 10 meters above ground, building-mounted, *etc.*) rather than distance from human presence. See *id.*

⁶⁴ Transmitters in the relevant subparts of Part 101 are exempt if building-mounted and their EIRP is less than 1640 watts, while all transmitters mounted on buildings operating under Part 30 must be evaluated. See 47 CFR § 1.1307(b)(1), tbl. 1.

⁶⁵ *Id.* The rule presumes that all transmitters on ships operating under Part 80 are not exempt regardless of how they are installed and, by a lack of inclusion in the table, simultaneously presumes that all non-ship transmitters are exempt. *Id.* Similarly, Satellite Communications Services (part 25), Radio Broadcast Services (part 73), and 76-81 GHz Radar Service (part 95): “Evaluation is required if . . . [a]ll included.” *Id.* On the other hand, services not listed in the Table are not required to be evaluated. See *id.* § 1.1307(b)(1) “[E]xposure limits in §§ 1.1310 and 2.1093 of this chapter are generally applicable to all facilities . . .”).

⁶⁶ The language in the rule stating that “[e]valuation required if” certain conditions exist for the enumerated services serves to exclude other conditions and categories of transmitters. See *id.*

⁶⁷ *Id.* § 1.1307(b)(1), tbl. 1. For example, Table 1 indicates that building-mounted antennas with effective radiated powers as high as 2,000 watts are not required to be evaluated, depending on the applicable service rules, regardless of how far a distance these transmitters are separated from areas where persons can access. *Id.* Effective radiated powers this high could be noncompliant at short distances (*e.g.*, ten meters as described in other parts of the Table) if not appropriately installed. *Id.*

⁶⁸ See *infra* Appx. A, Amended Rule 47 CFR § 1.1307(b)(1).

exposure (MPE) limits. For each class, we provide for both the single-transmitter case and the multiple-transmitter case. If the device or transmitter falls under one of these classes of RF exemptions, no additional action is necessary. If, on the other hand, the device or transmitter does not fall under one of these exemptions, the applicant or licensee will have to perform a routine RF evaluation to determine compliance with the exposure limits. Under the new rules, every applicant for equipment authorization and every licensee prior to deployment or commencement of operations seeking to be exempt will use the calculations in our rules to determine whether the device or transmitter falls under one of the three classes of exemptions.⁶⁹ If the applicant or licensee does not fall under one of the exemptions, it must perform a routine evaluation to determine compliance with our RF exposure rules.

23. The new rules do not impose any significant burdens on the impacted parties because the underlying exposure rules have not changed and the parties' obligations to comply with the RF exposure limits remain the same. The principal difference between the new exemptions and the old rules is the uniform consideration of the distance between the RF source and the location where a human could potentially experience exposure (i.e., separation distance), rather than wholesale exemption of service classes or operational presumptions.⁷⁰ We anticipate that in the vast majority of situations the transmitting antennas installed at stations used by the various services are separated from the public by distances greater than those specified in the new rules. In such cases, no further action will be necessary. For example, microwave stations operating under Part 101 of the rules were subject to the RF exposure limits but did not require routine evaluation. These stations operate on towers that are separated from the public by a distance greater than required for evaluation. On the other hand, if a transmitting antenna is located near to the ground and closer to the public than the specified distance, it would be appropriate for that station to be evaluated.⁷¹ In sum, we expect that if an RF source was "categorically excluded" or "exempt" from routine evaluation under the old rules, it will most likely still be exempt from routine evaluation under the rules we adopt today.⁷²

24. For those relatively few instances where an evaluation may be required under the new rules, we expect this will be fairly straightforward. The calculations require only information that the applicants already have on hand, notably the operating frequency and effective radiated power. For the most part, these calculations will result in conclusions that are similar to our old rules. We note that this information is not required to be routinely filed with the FCC. Further, to ease the transition to the new

⁶⁹ See *infra* Appx. A, Amended Rule 47 CFR § 1.1307(b)(2)(i)-(ii).

⁷⁰ See 47 CFR § 1.1307(b)(1), tbl. 1. Where previously applicants would compare the operating frequency specified, the maximum effective radiated power (ERP), and considerations including how high antennas are above ground or where they are intended to be mounted (e.g., on a building) to identify any possible exemption from evaluation provided for their particular service in the table, now the applicants will determine whether they are exempt based on the applicant's operating frequency, maximum ERP, and separation distance regardless of service type.

⁷¹ Separation distance can be ascertained when installers visit the transmitter site to install equipment prior to operation. See generally 47 CFR § 1.1307(b) regarding ongoing compliance expectations for all facilities, operations, and transmitters regulated by the Commission. But see Whedbee Comments at 3-9 (raising concerns about definitions of terms. We observe that separation distance is well-defined in relation to the radiating structure (i.e., antenna) and any part of the human body, and that by convention antenna efficiency is taken into account in antenna gain ($G = \eta D$) used to determine ERP).

⁷² The new exemption criteria will permit up to 1 kW ERP for a wireless base station operating at 850 MHz, or up to 2 kW ERP for a wireless base station operating at 1900 MHz, each separated by approximately ten meters to be exempt from evaluation, which is similar to what Table 1 presently allows. See 47 CFR § 1.1307(b)(1). Additionally, low-power broadcast stations operating at less than 100 W ERP would continue to be exempt if separated by at least five meters. See *id.*

rules, we establish a transition period below to allow licensees and manufacturers an opportunity to determine whether they meet the criteria for an exemption.⁷³

25. The proposals we adopt today received substantial support from commenters. The IT'IS Foundation, for example, supported the new exemption standards outright.⁷⁴ There were also several commenters, including WIA, Verizon, and AT&T, who provided qualified support for the proposal, favoring the Commission's general approach to the issue, but voicing concerns over the loss of existing exemptions.⁷⁵ Opposition to the proposal came primarily from parties that objected to the loss of service-based exemptions—Part 90 licensees, Part 101 licensees, and amateur radio operators—and claimed the changes would be unnecessary or burdensome.⁷⁶ Part 90 Private Users contend that the uniform application of the proposed exemptions would increase financial burdens on licensees that are not in the business of providing radio communications and do not control all of their antenna sites,⁷⁷ because it would require them to review each antenna site and verify adequate separation distances, even though there is no evidence in the record of non-compliance with the RF exposure limits.⁷⁸ Similarly, the Fixed Wireless Communications Coalition, Inc. (FWCC), representing the interests of terrestrial fixed microwave communications, argues that the proposals will require at least a preliminary calculation for every facility and that an “anomaly” in the exemption would require many installations to undergo further evaluation.⁷⁹ UTC also opposes the elimination of the existing exemptions by service for Part 90 and Part 101 because the antennas deployed for these services are typically mounted on structures with limited access and “generally do not pose a significant risk of exceeding the Commission's RF exposure limits.”⁸⁰

26. We note that RF exposure compliance requirements have been generally applicable to all facilities, operations, and transmitters regulated by the Commission. We recognize that the majority of the RF sources deployed by these parties and their members are mounted on towers or other structures

⁷³ See *infra*, Section IV.C, paras. 108-10.

⁷⁴ See IT'IS Foundation Comments at 3 (supports the exemptions as proposed).

⁷⁵ See WIA, formerly PCIA – The Wireless Infrastructure Association and The HetNet Forum (PCIA) Comments at 4-5; WIA Reply at 2-3 (generally supporting the proposed approach but argues proposed exemption criteria are needlessly restrictive); Verizon Comments at 3-4 (proposing a modified exemption formula, concerned that the proposed exemption criteria would result in network facilities losing their exempt status, including small cell and distributed antenna system (DAS) transmitters); AT&T Reply at 4-6 (acknowledging the benefit of streamlining the Commission's exemption rules, but supports the continued exemption of Part 101 microwave facilities).

⁷⁶ See CTIA Reply at 33-35 (echoing Verizon's concern, arguing that small cell sites “qualify as a case that presents little to no risk”); Private Users Comments at 2-4; FWCC Comments at 2-5; UTC Reply at 1, 3-7; AICC Reply at 1, 10, 14 (arguing to retain the existing service-based exemption for Part 90 Private Land Mobile Radio Service licensees; adopt the proposed exemption as an option, adopt a 2-watt blanket exemption at least for devices that are typically mounted with a separation distance of 20 cm, and apply any rule changes prospectively; suggests that there should be an automatic exemption at greater than 20 cm but that it is not clear whether our proposed exemption would apply at a separation distance of 20 cm or at 40 cm).

⁷⁷ Private Users Comments at 2-4.

⁷⁸ Private Users Comments at 2.

⁷⁹ FWCC Comments at 2-5. The commenters mention of a potential “anomaly” in an exemption rests on a misunderstanding of what entails an exemption versus a requirement for an evaluation described in more detail in Section IV.A and IV.B, respectively. The formulas in OET Bulletin 65 describe solutions for ERP at given distances rather than distance given ERP. See generally OET Bulletin 65, *supra* note 60.

⁸⁰ UTC Reply at 1, 3-7; see also AT&T Reply at 4-6 (supports the continued exemption of Part 101 microwave facilities, claiming that “microwave antennas are not typically placed where persons could intersect the microwave path ... [and] are typically deployed at substantial heights and produce a narrow beam” presenting a low risk of exposure).

well above ground with limited access. However, much has changed since the time exemption from RF evaluation of microwave installations on towers was first established. Fixed services are now often used for backhaul for wireless communications and can be located on publicly accessible rooftops and structures near ground level that are not necessarily spatially removed from publicly accessible areas at similar height.⁸¹ The Commission's objective is *consistently reliable* compliance with the existing exposure limits, and these sorts of installations warrant an affirmative determination that they are in fact exempt from routine RF exposure evaluation.⁸² Even though such an affirmative determination might require certain licensees to engage in additional effort, the Commission seeks to ensure that the public is adequately protected as new technologies, like 5G, flourish and more transmitters are deployed. We reiterate that the affirmative determinations only involve a simple analysis to determine whether an exemption is applicable.⁸³ Only in cases where the simple RF exemption criteria are not met would an evaluation, and likely a simple one, be needed to establish compliance.⁸⁴

27. We also recognize that many licensees do not control all of the sites at which their antennas are located. However, licensees cannot walk away from their obligations on this basis. Such leasing arrangements are contractual, and licensees can provide for owner attention to this obligation, including responsibility for any losses due to their failure to maintain compliance, as specific provisions of the lease.

28. Verizon contends that our rules may result in a number of network facilities losing their RF-exempt status.⁸⁵ We recognize that the new rules may, in some cases, require applicants and licensees to determine whether an evaluation for compliance with our RF exposure limits is necessary.⁸⁶ Assuming that these facilities comply with the existing RF exposure standards, we do not anticipate any different outcomes.⁸⁷ Moreover, we anticipate that the number of installations that meet the criteria where

⁸¹ Commenters discuss "typical" placements but do not address other placements, which are precisely the situations that may not be exempt and would appropriately require evaluation to ensure compliance. *See* Private Users Comments at 2-4; FWCC Comments at 2-5; UTC Reply at 1, 3-7; AICC Reply at 1, 10, and 14; AT&T Reply at 4-6.

⁸² *See supra* Section IV.E (where we adopt a two-year transition period for licensees to determine if RF exposure evaluations are required, to perform them where necessary, and to comply with the more specific mitigation requirements we adopt in this order as may be necessary).

⁸³ The factors and calculations used to determine whether a transmitter is exempt can be reused to provide a generic template for ready exemption from evaluation of numerous sites. Even when a full evaluation is conducted, such evaluation may only involve a rough calculation to show that RF levels are less than the exposure limits in our rules.

⁸⁴ FWCC argues that no evaluation should be required where there an installation in which the lowest antenna is 6.3 meters or more above accessible areas, using typical power and antenna directivity, because they demonstrate that compliance can be readily achieved at this distance. In considering antenna directivity—which is not included in our exemption formula—FWCC has performed an evaluation and demonstrated its relative simplicity, and any site with similar characteristics is readily determined to be compliant. Facilities with lower power, greater directivity, or greater height are obviously already effectively evaluated without site-by-site application of the formula. Letter from Cheng-yi Liu, Counsel, Fixed Wireless Communications Coalition, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-84, Attach. at 12 (filed Mar. 3, 2016).

⁸⁵ Verizon Comments at 3-4.

⁸⁶ Currently, 47 CFR § 1.1307(b)(1), tbl. 1 identifies services with operations and facilities meeting specific power, location and frequency criteria to be subject to RF exposure evaluation. In addition, 47 CFR § 1.1307(b)(2) requires mobile and portable transmitting devices operating under certain service rules to be evaluated. The new rules will replace these services with the streamlined exemption criteria and remove the specific references in the rules.

⁸⁷ MPE-based exemptions are derived from the MPE exposure limits in Section 1.1310 and Equation 6 of OET Bulletin 65 (Edition 97-01). "The rationale for this derivation is that if these conservative ERP and separation distance exemption criteria are met then there is minimal likelihood for the exposure limits for the general public to be exceeded." *See 2013 RF Order and Notice*, 28 FCC Rcd at 3620, App. C.

evaluation is needed will be relatively few. In those cases, as noted earlier licensees already have the necessary information on their transmitters and their installations and would only need to run very simple calculations to ensure compliance with the RF exposure limits.⁸⁸ This presumes, of course, strict adherence to—and where necessary, maintenance of—their installation protocols, and we are confident that licensees will so act. If there are cases where an RF evaluation is necessary and shows a particular RF source is out of compliance, mitigation or modification of the facility is obviously warranted.

29. Although the rules do not require Part 15 devices, except those operating under the provisions of Sections 15.255, 15.257, 15.319, and 15.407,⁸⁹ to provide a routine environmental RF exposure evaluation prior to equipment authorization,⁹⁰ the Commission, nonetheless, requires an evaluation where there is a potential for RF exposure caused by either higher-power emissions or operation in close proximity to users, such as Wi-Fi routers used in residential environments.⁹¹ Commenters like the Alarm Industry Communications Committee (AICC) and UTC argue that low-power/unlicensed devices, used in for example smart meters in homes and businesses, should continue to be exempt as they would be under the old rule.⁹² Our actions in this *Order* will not change these and similarly situated parties' obligations or burdens because the formula underlying the new rules results in similar exemptions as the old rules.⁹³

30. We further clarify that equipment authorized prior to the effective date of this *Order* may continue to be marketed and used under their existing authorizations. Parties deploying such equipment need only ensure that the equipment is installed consistently with the information in the installation manual or user instructions, as provided in the equipment approval, and no further analysis is necessary. In other words, no determination or evaluation for compliance with the RF exposure rules will be required for example low power or unlicensed devices that have been determined compliant with the RF exposure rules under the existing equipment authorization process.⁹⁴

⁸⁸ To whatever extent such a review may reveal that prior practices resulted in potential noncompliance with our RF exposure rules, such new information cannot be considered a new “burden,” and the obligation to comply has been in place prior to this action.

⁸⁹ 47 CFR §§ 15.255, 15.257, 15.319, 15.407.

⁹⁰ These exemptions are based on calculations and measurement data indicating that such devices under conditions of normal use are unlikely to cause exposures exceeding the guidelines. It should be emphasized, however, that these are not exemptions from compliance, but, rather, only exemptions from routine evaluation. Transmitters or facilities that are otherwise exempt from routine evaluation may be required, on a case-by-case basis, to demonstrate compliance when evidence of potential non-compliance of the transmitter or facility is brought to the Commission's attention, pursuant to 47 CFR § 1.1307(c), (d).

⁹¹ See KDB Publications 447498, 616217, 680106.

⁹² AICC Reply at 1, 10, 14; UTC Reply at 3. Like with mobile devices defined in Section 2.1091(b), smart meters are designed generally to be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the bodies of any nearby persons; as such, such devices qualify for exposure evaluation using MPE limits rather than SAR limits.

⁹³ See *App.* A Section 1.1307(b)(1)(B).

⁹⁴ Where the transmitter is approved as a modular transmitter under Section 15.212, and gets integrated into a host device, the host device manufacturers must ensure compliance with the conditions of the modular equipment authorization grant or must perform a new separate evaluation for the host for RF exposure compliance. For example, a module approved for a mobile device application and used in a portable device application will need a new RF exposure evaluation to the extent that the integration is not conforming with the condition of the module's underlying equipment authorization.

31. As with any other service that would have been otherwise categorically exempt from routine evaluation,⁹⁵ the replacement of the service-based exemptions effectively eliminates the exemption from routine RF exposure evaluation for Part 18 devices. Many types of Part 18 devices are Industrial, Scientific, and Medical (ISM) equipment often subject to regulatory requirements from other federal agencies⁹⁶ that, due to their controlled occupational operating environments (most often in industrial, medical, or manufacturing facilities), do not present issues or concerns regarding human exposure to RF.⁹⁷ Although the new rules will now require a demonstration of compliance for all Part 18 devices by way of an RF exposure exemption determination or a routine RF exposure evaluation, many of these devices already undergo extensive evaluations associated with RF exposure as part of the regulatory compliance obligations of other federal agencies. The new rules do not require any additional evaluation beyond what they should already undertake. Further, because many Part 18 devices tend to operate in a closely controlled professional environment, any RF concerns can be addressed through mitigation.

32. The American Radio Relay League (ARRL) argues that the routine evaluation exemption for amateur radio stations that operate below a certain power threshold should be maintained.⁹⁸ We are not persuaded that the existing requirement, which limits routine evaluation only to higher-powered amateur station transmitters regardless of distance, is adequate to avoid inadvertent non-compliance with the RF exposure limits. Amateur radio licensees operate a variety of installations of different size, power, and frequency, which can be located in close proximity to people, giving rise to various RF exposure concerns. This further supports the need for consideration of more than just transmitter power alone, as the previous rules had done, as a basis for determining compliance with our RF exposure rules. If the antenna performance characteristics are known, then the process of determining whether the facility is exempt from routine RF exposure evaluation would be as simple as accounting for distance separation to accessible areas in conjunction with the known ERP and operating frequency.⁹⁹ For situations where

⁹⁵ Radio services wholly exempt from RF exposure routine evaluation are not explicitly included in either Table 1 of Section 1.1307(b)(1) or in Section 1.1307(b)(2).

⁹⁶ For example, magnetic resonance imaging (MRI) systems and medical equipment subject to Food and Drug Administration (FDA) regulations. *See, e.g.*, 21 CFR § 1010.2.

⁹⁷ *See Amendment of Part 18 of the FCC Rules to exempt medical ultrasonic diagnostic and monitoring equipment from technical standards*, Gen Docket No. 85-303, Report and Order, 1 FCC Rcd 553, 553, para. 6 (1986) (stating that “we find that it would be in the public interest to exempt non-consumer medical ultrasonic diagnostic and monitoring equipment from certain administrative and technical standards of Part 18” and that “this exemption will enhance the benefits derived by society from the application of ultrasonics in the field of medicine by reducing the design (including research and development) and marketing costs of monitoring and diagnostic equipment”). Later, in 1994, the Commission added magnetic resonance imaging (MRI) equipment to this list. *See Amendment of Part 18 of the FCC Rules to Remove Unnecessary Regulations Regarding Magnetic Resonance Systems*, ET Docket No. 92-255, Report and Order, 9 FCC Rcd 3389, 3389-90, paras. 6-9 (1994); *see also* <https://www.osha.gov/SLTC/radiofrequencyradiation/index.html>.

⁹⁸ *See* ARRL Comments, ET Docket No. 13-84, at 2-6. Under 47 CFR 97.13(c)(1), amateur radio operators were exempt from evaluation based on power regardless of separation distance. ARRL states that its concern arises from an apparently uneven regulatory burden that disproportionately prejudices amateur radio licensees, and it further asks the Commission to state unequivocally that its exemption criteria “are the preemptive standard, and that States, municipalities, and private land use regulatory authorities such as homeowners’ associations cannot adopt their own, more stringent standards which might preclude or unreasonably restrict the installation of Amateur Radio stations, allegedly due to RF exposure considerations.” *Id.* at 6; *see also* Whedbee Comments at 3-9 (arguing that for amateur operations, technical considerations such as antenna efficiency at lower frequencies and defining separation distance make the proposed exemptions unenforceable); Leggett Comments at 2-5 (claiming that there could be various negative impacts on the amateur community due to the proposals, but that these impacts could be alleviated by authoritative computer models of RF exposure and additional written information provided by the Commission).

⁹⁹ Various simplifying conservative assumptions can be made; for example, if the height of an antenna above unpopulated space is known and is greater than required by the applicable exemption criterion, there is no need to

(continued....)

antenna performance characteristics may not be well understood for a particular amateur radio installation, the most feasible option of demonstrating compliance remains to be evaluated, and various resources exist to alleviate any burdens that may exist.¹⁰⁰ In addition, for low-frequency, low-efficiency antennas such as those used by many amateur radio licensees, evaluation generally was already required and will continue to be required under the new rules.¹⁰¹

33. We disagree with ARRL's interpretation of the impact of the new exemptions on amateur radio service operations.¹⁰² Contrary to ARRL's desire to interpret our exemptions as precluding any local or municipal RF regulation on amateur radio, our rules will have the same effect on amateur radio – amateur radio facilities were always subject to evaluation when warranted for a particular installation.¹⁰³ Exemptions are a first step in determining RF compliance, and licensees or operators are permitted to choose between determining whether a facility is exempt from routine RF exposure evaluation, or complies with the RF exposure limits based on an evaluation.¹⁰⁴ An exemption determination alleviates the burden of evaluating RF exposure compliance by establishing the unlikelihood of causing exposures that exceed the limits under normal conditions of use, but is not an exemption from compliance, only from routine RF exposure evaluation.

34. We accordingly conclude that as wireless technology rapidly advances, the new requirements of determining and demonstrating RF exposure compliance will best serve all stakeholders. Eliminating service-based exemptions and replacing them with exemptions that are applied uniformly, regardless of the service being offered, simplifies the compliance framework. It ensures that RF sources qualifying for an exemption are in consistently reliable compliance with the applicable exposure limits. The exemptions are tailored to apply only to those uses where the potential of harm to the public is minimal, and the clear and easily applicable standards allow for manufacturers and innovators to readily

(Continued from previous page)

measure lateral distance and calculate the hypotenuse, as that distance will always be greater than the (known) vertical distance.

¹⁰⁰ When evaluation is required, additional guidance is available in tabulated generic analyses of compliance for broad classes of antennas and installations from the Commission and third parties. See FCC Office of Engineering at Technology, Additional Information for Amateur Radio Stations, OET Bulletin 65, Supplement B, (1997); Ed Hare, *RF Exposure and You*, The Amateur Radio Relay League (1998). This guidance has been available for years and is an acceptable method to determine compliance. These resources were developed by the Commission and private amateur groups, including the ARRL, to aid in determining compliance with the exposure limits. See *id.*

¹⁰¹ That is because exposure is in the reactive near-field and therefore requires further analysis to ensure compliance with our RF exposure rules. See Environmental Protection Agency, *Near-Field Radiation Properties of Simple Linear Antennas with Applications to Radiofrequency Hazards and Broadcasting*, Tell, Richard A., ORP/EAD 78-4 (June 1978).

¹⁰² ARRL Comments at 24 (arguing that the Commission should preempt non-federal RF exposure standards more restrictive than those adopted by the Commission absent a showing that a scientific basis exists for a compelling need for the more stringent regulation or restriction).

¹⁰³ ARRL Comments at 6-7.

¹⁰⁴ Although Section 332(c)(7)(B)(iv) expressly prohibits local governments from regulating “personal wireless service” facilities on the basis of the environmental effects of RF emissions to the extent that such facilities comply with the regulations contained in this chapter concerning the environmental effects of such emissions, these restrictions do not apply to the amateur service. *Modification and Clarification of Policies and Procedures Governing Siting and Maintenance of Amateur Radio Antennas and Support Structures, and Amendment of Section 97.15 of the Commission's Rules Governing the Amateur Radio Service*, Order, 14 FCC Rcd 19413 (1999) (“Section 704 of the Telecom Act, which, among other things, bars state or local regulations that prohibit or have the effect of prohibiting the provision of personal wireless services, does not apply to stations or facilities in the amateur radio service.”).

determine compliance with RF exposure limits. By adopting a service-agnostic approach to exemptions, our rules will no longer unduly burden developers who are making new uses of wireless technology.

1. Exemption Criteria - Single RF Source

35. As proposed in the *2013 RF Further Notice*, a single RF source will be exempt from routine RF exposure evaluation under any one of three circumstances: 1) the RF source transmits at no more than 1 mW average power; 2) the RF source normally operates between 0.5 cm and 40 cm separation from the body, in the frequency range between 300 MHz and 6 GHz, and transmits at no more than the average power threshold result of the formula we adopt based on localized specific absorption rate (SAR) limits; or 3) for all other transmitters, (a) the RF source transmits at no more than the average power threshold result of the set of formulas we adopt based on the maximum permissible exposure (MPE) limits, and (b) the intended operation is normally separated at a distance from any part of the radiating structure of at least $\lambda/2\pi$, where λ is the free-space operating wavelength. These specific exemption criteria are a generally-applicable set of formulas, based on power, distance, and frequency, for all services using fixed, mobile, and portable transmitters. We explain each of these three criteria in turn.

a. 1-mW Blanket Exemption

36. For fixed, mobile, and portable RF sources, we adopt a blanket exemption of 1 mW of time-averaged available (matched conducted) power for RF sources irrespective of distance from the body, as proposed in the *2013 RF Further Notice*.¹⁰⁵ The 1-mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it may not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from these higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.¹⁰⁶ Also, we clarify that the 1-mW blanket exemption applies at separation distances less than 0.5 cm,¹⁰⁷ including where there is no separation. The record reflects that, at this level of power, emissions from RF sources would fall safely under our existing SAR or MPE exposure limits, which we do not disturb today.¹⁰⁸ Therefore, at these power levels, a blanket exemption, rather than a requirement for RF exposure evaluation or determination of exemption by other means, is appropriate.

¹⁰⁵ See *2013 RF Order and Notice*, 28 FCC Rcd at 3538, para. 121.

¹⁰⁶ See *id.*

¹⁰⁷ See IT'IS Foundation Comments at 3 (seeking clarification that the 1 mW exemption applies at separation distances less than 0.5 cm, even while the SAR-based exemptions are not valid at less than 0.5 cm); *2013 RF Order and Notice*, 28 FCC Rcd at 3555, para. 168. Modern transmitting implants are generally too small to allow 0.5 cm or more of separation distance and the impact on SAR of dielectric material that could be used to increase separation between antennas and tissue is unknown. See Appx. A, 47 CFR § 1.1307(b)(1)(i)(A).

¹⁰⁸ See Motorola Comments at 4 (“As the Commission notes, under current rules, any transmitter with power of 1.6 mW or lower will be inherently compliant with the Commission’s specific absorption rate (“SAR”) limit, so conducting routine evaluations on any such devices is unnecessary.”); Medtronic Comments at 3 (“The Commission’s localized SAR limit of 1.6 W/kg averaged over 1 gram cannot be exceeded if the available power from a transmitter is less than 1.6 mW, regardless of frequency and distance over the applicable SAR frequency range of 100 kHz to 6 GHz. Put differently, single transmitters operating at 1 mW cannot exceed the Commission’s exposure limits based on conservation of energy principles. Thus, a blanket exemption from routine environmental evaluation for these transmitters is appropriate.”); Wi-Fi Alliance Comments at 3 (“the proposed 1 mW exclusion and the scale proposed by the Commission are overly conservative and are inconsistent with current devices. Adoption of the IEC standard will reduce unnecessary and costly compliance testing.”); Wi-Fi Alliance Reply at 11 (“Many parties agreed with Wi-Fi Alliance that the current 1 mW exclusion is unnecessarily conservative and that the Commission should adopt the IEC 62479 standard instead.”).

37. The medical implant community largely supports the new rule. Medtronic, Inc. (Medtronic), for example, states that it strongly supports the exemption on the ground that it will streamline approval and lower development costs and time-to-market for new medical devices.¹⁰⁹ The Cardiac Rhythm Management Device Committee/Working Group 2 on EMC Protocols of the Association for Advancement of Medical Instrumentation (AAMI-CRMD) similarly supports the underlying principles of the 1 mW exemption, commenting that such a measure would simplify regulatory approval for all medical device manufacturers.¹¹⁰

38. Medtronic and the AAMI-CRMD recommend a more relaxed threshold of 20 mW to align with more recent RF exposure guidelines and to support future devices, which are expected to have improved batteries and may operate with greater average power.¹¹¹ They contend that while most of the existing (transmitting) implants would fall below the 1-mW threshold because of existing battery constraints, greater power will be needed in the future to accommodate the increased range, data rates, and reliability anticipated in the next generations of devices.¹¹² We decline to increase the 1-mW threshold. The blanket 1-mW exemption is based on the existing Commission SAR limit below 6 GHz (and on the existing Commission MPE limit above 6 GHz).¹¹³ They do not compellingly make the case to change the Commission's existing underlying SAR limit to another upon which 20 mW would be based, and we decline to do so at this time. Moreover, our new rules do not prohibit the authorization of medical implants operating with power exceeding 1-mW; only that such devices would require routine evaluation for certification, which until now had been the case for all implant devices that contain wireless communications capabilities.¹¹⁴

39. Motorola suggests that the general public SAR limits should not apply when requesting an exemption for exposure from implanted medical devices.¹¹⁵ Instead, Motorola suggests applying IEC 60601-2-33 for implanted medical devices,¹¹⁶ which provides higher SAR limits, (e.g., normal partial body SAR ranging between 2 W/kg and 10 W/kg, as averaged over 10 grams, depending on exposed mass) on the grounds that these devices are implanted under medical supervision.¹¹⁷ We will not consider such a change, as the issue is outside the scope of this rulemaking. Our rules will continue to provide that all devices using RF energy for communications (or, e.g., power transfer) in a medical context are subject to Commission RF exposure limits for purposes of requesting an exemption.

¹⁰⁹ See Medtronic Comments at 2-3.

¹¹⁰ See AAMI-CRMD Comments at 5.

¹¹¹ See Medtronic Comments at 2-3, 5; AAMI-CRMD Comments at 5.

¹¹² AAMI-CRMD suggests that the Commission increase the exemption level consistent with the SAR limits from IEEE standards and ICNIRP guidelines. IEEE-ICES urges the Commission to adopt the local SAR limit of 2 W/kg averaged over 10 g of tissue that would result in a blanket exemption power of 20 mW. (IEEE-ICES Comments at 9.) As discussed in our resolution of this issue, these arguments are based on SAR limits that are different from those in our extant rules and thus are outside the scope of this rulemaking. See *supra* para. 37.

¹¹³ See 47 CFR § 1.1310.

¹¹⁴ See 47 CFR § 1.1307(b)(2).

¹¹⁵ See Motorola Comments at 6.

¹¹⁶ International Electrotechnical Commission, International Standard IEC 60601-2-33, Edition 3.0, "Medical electrical equipment - Part 2-33: Particular requirements for the basic safety and essential performance of magnetic resonance equipment for medical diagnosis" (2010).

¹¹⁷ See *id* at 4-7.

40. Motorola urges the Commission to adopt the International Electrotechnical Commission (IEC) 62479 (2010) criteria,¹¹⁸ which provides a 1.6-mW exemption from 100 kHz to 6 GHz as a blanket exemption. We disagree. Adopting the 1.6 mW standard is not appropriate because it does not include a margin for power measurement uncertainty.¹¹⁹ As a result, a 1.6 mW standard could reasonably result in RF exposure in excess of our SAR limit.

41. CDE expresses caution with respect to use of the 1-mW threshold for non-medical devices because of possible device software reconfiguration to operate at higher power.¹²⁰ CDE is concerned of possible changes to the device after its grant of authorization. However, our rules require that the responsible parties certify that the equipment marketed under the grant of certification conforms with the rated operational characteristics of the unit for which measurements were filed with the application of certification.¹²¹ Any radio in which the software is designed to be modified by a third-party other than the manufacturer must comply with the requirements of a software defined radio specified in Section 2.944 of our rules.¹²² The applications for certification will have to show clearly the maximum possible power of operation and, if there is software to control it, also describe the procedures to ensure that it cannot be modified.¹²³ If the device is capable of operating at power levels greater than permitted by the exemption threshold, it will not be authorized. If there is unauthorized modification, the device will be operating outside its grant of authorization and subject to enforcement action.¹²⁴

b. SAR-Based Exemption

42. The SAR-based thresholds are derived based on the frequency, power, and separation distance of the RF source.¹²⁵ The formula in Table 1 defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.¹²⁶ If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may

¹¹⁸ International Electrotechnical Commission, International Standard IEC 62479, Edition 1.0, “Assessment of the compliance of low-power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)” (2010).

¹¹⁹ Analogously, in the FCC Laboratory’s guidance on SAR compliance, test reduction procedures incorporate an additional margin (typically 1.2 W/kg or less compared to 1.6 W/kg) for similar reasons.

¹²⁰ See CDE Comments at 2.

¹²¹ 47 CFR § 2.931.

¹²² 47 CFR § 2.944.

¹²³ 47 CFR § 2.1033.

¹²⁴ 47 CFR § 2.803.

¹²⁵ See *2013 RF Order and Notice*, 28 FCC Rcd at 3624, Appx. D. The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, including those occupationally exposed, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

¹²⁶ Certain service rules use equivalent isotropically-radiated power (EIRP) rather than ERP, which is defined in our new rules (47 CFR § 1.1307(b)) for exemption purposes as the product of the maximum time-averaged power delivered to the antenna and its maximum gain in any direction relative to a half-wave dipole. EIRP equals 1.64 times the ERP. Similar to the definition of ERP, the definition of EIRP is the product of the maximum time-averaged power supplied to the antenna and its maximum gain in any direction relative to an isotropic antenna. Since our exemption criteria are defined in terms of ERP, we do not include this definition for EIRP in our rules, rather the exemptions for EIRP for service rules that use it may be derived by multiplying instances of ERP in our exemption formulas by this 1.64 factor.

use the available maximum time-averaged power¹²⁷ exclusively if the device antenna¹²⁸ or radiating structure does not exceed an electrical length of $\lambda/4$.¹²⁹ As for devices with antennas of length greater than $\lambda/4$ where the gain is not well defined but always less than that of a half-wave dipole (length $\lambda/2$), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known. This would apply, for instance, to “leaky” coaxial distribution systems, RF heating equipment, and other (typically unintentionally) radiating or Industrial, Scientific, and Medical (ISM) devices. The SAR-based exemption threshold P_{th} is defined in terms of maximum time-averaged power and in accordance with the source-based time-averaging requirements described in section 2.1093(d)(5). Time-averaged power measurements are necessary to determine if the maximum output of a transmitting antenna (ERP) or transmitter matched conducted power is above the proposed threshold for exemption or routine SAR evaluation.¹³⁰

¹²⁷ This available maximum time-averaged power would be the maximum power delivered into a matched antenna, considering line loss or any other loss that diminishes power delivered to an antenna.

¹²⁸ A coherent phased array of antenna elements is to be treated as a single antenna or RF source because coherent fields sum by field strength and not by power, so the summation given later should not be used in this case. Separation distance of a coherent phased array of antenna elements is from the nearest element.

¹²⁹ See Roger F. Harrington, *Effect of Antenna Size on Gain, Bandwidth, and Efficiency*, 64D, No. 1, Journal of Research of the National Bureau of Standards, Radio Propagation 1-12 (January-February 1960).

¹³⁰ The power measurement and SAR test procedures required to determine the number and types of SAR tests necessary to demonstrate device compliance will be available in procedures established by the OET Laboratory and published in the KDB. KDB publications have referenced 3GPP and 3GPP2 power measurement requirements; however, when such test configurations and procedures are not appropriate for SAR or RF exposure evaluation purposes, the OET Laboratory will provide power measurement guidance. Moreover, some power measurement procedures may be specific to the particular wireless technology under consideration (e.g., Wi-Fi).

Table 1. Time-Averaged Power Thresholds (mW) for Exemption of Single Portable, Mobile, and Fixed RF Sources, 0.3-6 GHz

A source is exempt if each of the maximum time-averaged available (matched conducted) power and effective radiated power (ERP) is no more than:													
$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$													
where:													
$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and}$													
$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$													
Use the formula at distances (d) from 0.5 cm to 20 cm and frequencies from 0.3 GHz through 6 GHz; the constant values obtained by the formula at exactly 20 cm apply between 20 cm and 40 cm. Units for <u>d</u> are cm and units for <u>f</u> are GHz. Example values shown in the following table are for illustration only.													
Frequency (GHz)	Example Power Thresholds (mW)												
	Distance (cm)												
	0.5	1	1.5	2	2.5	5	7	10	12.5	15	17.5	20	40
	0.3	39	65	88	110	130	220	280	360	430	490	550	610
	0.45	22	44	67	89	110	230	320	460	570	690	800	920
	0.835	9.2	25	44	66	90	240	390	640	880	1100	1400	1700
	0.9	8.3	23	42	63	88	240	400	670	920	1200	1500	1800
	1.45	4.3	15	30	50	74	250	460	870	1300	1800	2300	3000
	1.8	3.5	13	26	45	67	240	450	860	1300	1800	2400	3060
	1.9	3.4	12	26	44	66	240	440	850	1300	1800	2400	3060
	2.45	2.7	10	22	38	59	220	420	820	1300	1800	2400	3060
	3	2.3	9.0	20	35	53	210	400	790	1200	1700	2400	3060
	5.2	1.5	6.3	15	26	42	170	350	730	1200	1700	2300	3060
	5.8	1.4	5.9	14	25	40	170	340	720	1100	1700	2300	3060

43. This formula provides a straightforward and easy-to-use method for regulated parties to use as part of the process in evaluating their compliance with the existing RF exposure limits. The algorithm accounts for the major contributing variables in RF exposure (frequency, distance, and power), ensuring that exposure levels stay safely below our established limits. We have set the parameters of this formula to cover a wide range of use cases, while not unnecessarily complicating the calculations, allowing parties to readily determine if a device qualifies for the exemption.

44. A number of parties support the Commission's uniform formula for SAR exemption.¹³¹ For example, the IT'IS Foundation supported the principle of the SAR-based exemption, agreeing that the

¹³¹ See IT'IS Foundation Comments at 3 (supports the exemptions as proposed and finds them consistent with its research and easy to apply). As indicated in the 2013 RF Order and Notice, this approach to exemptions came about from commenters in response to our 2003 Notice offering broad support for the idea of simplifying our criteria and making them consistent across all services, and for the Commission to consider a "sliding scale" or a more detailed scheme for defining exemptions based on simple calculation methods. See 2013 RF Order and Notice, 28 FCC Rcd at 3545, para. 140.

exemption should be based on physical characteristics rather than service type and that such exemptions are consistent with protecting the public, while reducing the costs of regulation.¹³²

45. Other commenters suggested alternatives to our proposed approach, but we decline to adopt them. The Wi-Fi Alliance contends that the proposed SAR-based exemptions are too conservative and inconsistent with the operation of current devices.¹³³ Similarly, IEEE-ICES urges the Commission to adopt a higher SAR exposure limit of 2 W/kg averaged over 10 g, a limit used elsewhere in the world and resulting in RF exposure levels that are significantly higher than those under our rules.¹³⁴ Instead, these parties support the use of technical standard IEC 62479 (2010), which provides alternative recommendations for exemption of low-power devices based on SAR.¹³⁵

46. We are not persuaded that the IEC standard should be adopted at this time. Even though the IEC's standard—like our proposal—uses dipoles and flat phantoms¹³⁶ as a starting point for modeling and the same frequency range (300 MHz-6 GHz), it departs significantly with respect to the applicable range of separation distances and use of bandwidth, with increased complexity in the resulting formulas. In an effort to maintain simplicity, we have limited the exemptions to those based solely on the relationship of power (both available or matched power and ERP), distance, and frequency without other inputs that would effectively render an exemption determination as complex as an evaluation (such as antenna pattern or bandwidth). Additionally, while our proposal uses a separation distance of 0.5- cm to 40 cm, the IEC standard uses a smaller distance, 0.5 cm to 2.5 cm. This is problematic, because numerous devices that might be subject to the SAR-based exemption operate with a separation distance of more than 2.5 cm.¹³⁷ Further, the rules we adopt use a reduced target SAR value in derivation in order to cover the range of several device parameters including bandwidth, while IEC uses transmitter bandwidth as a parameter to allow higher powers for wider bandwidth devices,¹³⁸ reducing the simplicity of this SAR exemption.

47. As the IT'IS Foundation and Whedbee point out, there are several other parameters that could be considered besides bandwidth, but we conclude that additional complexity in the exemption formula would result in regulations that are of little or no practical utility as a simple exemption protocol; additional factors can be taken into account as needed or appropriate in a more thorough evaluation to demonstrate compliance.¹³⁹ Finally, the IEC model does not directly incorporate antenna directivity and

¹³² See IT'IS Foundation Comments at 2-3.

¹³³ Wi-Fi Alliance Comments at 3.

¹³⁴ IEEE-ICES Comments at 9 (referencing Annex A of IEC 62479 and recognizing that the blanket exemption (up to 6 GHz) has been derived from the existing SAR limit).

¹³⁵ See Wi-Fi Alliance Comments at 3; IEEE-ICES Comments at 9; Motorola Comments at 5-6; MWF Comments at 4,13-14 (encourages the use of IEC 62479, but also supports the use of time-averaged power).

¹³⁶ A flat phantom is a planar model of absorbing tissue.

¹³⁷ MWF suggests we include an explanation of why our SAR-based exemptions are constant at separation distances between 20 cm and 40 cm. See MWF Comments at 14. We clarify that these constant values avoid discontinuities in the threshold when transitioning between SAR-based and MPE-based exemption criteria at 40 cm, considering the importance of reflections.

¹³⁸ SAR is simpler and results in no more exposure (and often less) than the IEC formulation. See *2013 RF Order and Notice*, 28 FCC Rcd at 3624, Appx. D.

¹³⁹ IT'IS Foundation Comments at 3; Whedbee Comments at 9 (Whedbee objects to the purported complexity of our proposed exemption criteria but appears to overlook that not all potential exemption input parameters are necessary to ensure compliance in most situations and that further simplicity could make the exemptions more conservative than necessary).

states that it may not apply to devices with highly directive antennas;¹⁴⁰ however, the new rules address this by limiting ERP (in addition to available power) which accommodates the greater exposure that may result from antenna directivity. In addition, with respect to IT'IS Foundation's suggestion that we extend the SAR-based exemption formula from 0.5 cm to 0 cm to account for wearable technologies, we decline to do so, because there is no modeling data that validates such an extension.¹⁴¹

c. MPE-Based Exemption

48. We also adopt our proposed general frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds in Table 2 to support an exemption from further evaluation from 300 kHz through 100 GHz in frequency, as proposed in the *2013 RF Order and Notice*.¹⁴² The table we adopt applies to any RF source (i.e. single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria, shown in Table 2 below, apply at separation distances from any part of the radiating structure of at least $\lambda/2\pi$.¹⁴³ The thresholds in Table 2 are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator. When the maximum time-averaged effective radiated power is no more than the value calculated from the formulas, the source is exempt from further evaluation.¹⁴⁴ The record reflects that, at the levels of power, distance, and frequency reflected by this formula, emissions from RF sources would fall safely under our existing MPE exposure limits, which we do not disturb today.¹⁴⁵ Therefore, an exemption at the threshold ERP levels reflected in Table 2, rather than case-by-case evaluation, is appropriate.

¹⁴⁰ IEC 62479, Edition 1.0, at 14, Annex B.

¹⁴¹ See IT'IS Foundation Comments at 3.

¹⁴² See *2013 RF Order and Notice*, 28 FCC Rcd at 3540-44, paras. 128-138.

¹⁴³ In Table 2, if $R < \lambda/2\pi$, evaluation is required. Since $\lambda/2\pi$ is > 20 cm at frequencies below 239 MHz, these exemption criteria do not apply to portable devices that are operated both at less than 20 cm from the body and at frequencies below 239 MHz. In general, less restrictive SAR-based exemption criteria may be used in accordance with the formulas specified in Table 2, but these SAR-based exemptions are not valid below 300 MHz. Thus, there are no exemption criteria below 239 MHz for portable devices (or for any antenna at less than 20 cm) other than the 1 mW blanket exemption. The $\lambda/2\pi$ distance in meters may be conveniently calculated using the formula: $47.7/f$ where f is the operating frequency in megahertz.

¹⁴⁴ See *2013 RF Order and Notice*, 28 FCC Rcd at 3620, Appx. C; see also OET Bulletin 65, Equation 6. In some cases, where ERP is not well defined the available maximum time-averaged power may be used as Threshold ERP. See *id.* at 3512, para. b. Also, rather than specify inequality formulas in Table 2, we instead, specify thresholds where an equal or lesser ERP to the Threshold ERP specified in Table 2 for the transmitter operating frequency would be considered exempt from evaluation.

¹⁴⁵ See WIA Comments at 4; Motorola Comments at 4; Wi-Fi Alliance Comments at 2; Verizon Reply at 2-4.

Table 2. Single RF Sources Subject to Routine Environmental Evaluation under MPE-Based Exemptions, $R \geq \lambda/2\pi$

Transmitter Frequency	Threshold ERP
0.3 – 1.34	1,920 R ²
1.34 – 30	3,450 R ² /f ²
30 – 300	3.83 R ²
300 – 1,500	0.0128 R ² f
1,500 – 100,000	19.2 R ²
<i>Note:</i> Transmitter Frequency is in MHz, Threshold ERP is in watts, R is in meters, f is in MHz.	

49. Single RF sources are exempt if, using Table 2 above, for the frequency (f in MHz) and separation distance (R in meters) at which the source operates, the ERP (in watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 2 to apply, the separation distance in meters, R,¹⁴⁶ must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength. If the ERP of a single RF source is not easily obtained, then the available maximum (source-based) time-averaged power may be used in lieu of ERP if the device antenna(s) or radiating structure(s) do not exceed the electrical length of $\lambda/4$. If the ERP of the single RF source and transmitting antenna(s) (including coherent array) exceeds the ERP threshold, then the RF source is not exempt and the applicant must prepare an evaluation.¹⁴⁷

50. As with our SAR-based exemption, we have crafted our MPE-based exemption to ensure that any source falling within the exemption will not expose members of the public to RF levels beyond our established standards. The formula for the MPE-based exemption is designed to apply to a wide range of applications, while still ensuring a relatively simple calculation.

51. A number of commenters expressed support for our proposed approach. WIA commented in favor of replacing service-based exemptions with broadly applicable standards, noting that service-based exemptions were subject to change and thus difficult to keep up to date.¹⁴⁸ Similarly, Motorola generally supported the notion of developing an MPE-based exemption based on power, distance, and frequency, noting that because RF exposure is a function of these factors “it is sensible to identify minimum thresholds below which evaluation is unnecessary.”¹⁴⁹

52. Even though WIA supports this approach, it contends that the exemption criteria are too restrictive and suggests adjusting the formulas to more readily exempt transmitters mounted on dedicated, access-controlled wireless support structures in the frequency range of 300 MHz to 3 GHz.¹⁵⁰ Similarly,

¹⁴⁶ The definition for separation distance in this calculation is identical to that concerning SAR-based thresholds. See *supra* para. 42.

¹⁴⁷ At sites with multiple fixed transmitters, or with multiple mobile or portable transmitters within the same device, the formulas would be applied in conjunction with the summations discussed in the section on Exemption Criteria - Multiple RF Sources, Section IV.A.2 below.

¹⁴⁸ See WIA Comments at 4.

¹⁴⁹ See Motorola Comments at 5.

¹⁵⁰ WIA Comments at 4-5; WIA Reply at 2-3; Verizon Comments at 3-4 (contends that the Commission’s proposal mixes spatially-averaged and spatial-peak power density which results in an over-estimation of far-field power (continued....))

Verizon proposes a modified exemption formula—one that would apply between 400 MHz and 3 GHz,¹⁵¹ concerned that the proposed exemption criteria would result in a number of network facilities losing their exempt status.¹⁵² WIA and Verizon argue that certain transmitters would present a *de minimis* risk of non-compliance with our rules.¹⁵³

53. Given recent developments in wireless infrastructure deployment, we conclude it is more appropriate to adopt refraining from such a broad alternative exemption formula for small cell or DAS transmitters. Rather, the exemption formulas we adopt in this *Order* will apply to small cell or DAS transmitters, as it does to other transmitters as well.¹⁵⁴ Further, for similarly-located small cell deployments that share technical characteristics (i.e. a small cell deployment with the same equipment placed at the same height), licensees can use the same exemption for all such small cell deployments. Although small cell and DAS transmitters were likely to be exempt under our previous rules, those exemptions were premised on the assumption that they were not being placed in or near publicly accessible areas.¹⁵⁵ The fact that small cell or DAS transmitters are “building-mounted” today does not preclude persons from having access to the front of antennas that could previously be presumed to always be distant from people, particularly when mounted low to the ground or in other accessible locations, and the actual distance from potential human presence should be taken into consideration.¹⁵⁶

54. Further, we decline to adopt Verizon’s proposal to relax the standard for “transmitters located on structures where access can more readily be controlled.”¹⁵⁷ While a supporting structure, such

(Continued from previous page) _____

density and a threshold power density that is too low, which would result in more transmitters not being considered exempt).

¹⁵¹ Verizon Comments at 3-4.

¹⁵² Verizon Comments at 3-4; Verizon claims that while the Commission’s use of 100 percent reflection in its derivation is appropriate to predict peak power density, it is inappropriate for predicting spatially-averaged power density, based on ground reflection and spatial averaging along a vertical line. Verizon is the only commenter to attempt to substantiate its argument - in its Technical Appx. A, it provides a technical justification of its conclusion that between 400 MHz and 3 GHz access-limited transmitters should be exempt if their ERP in watts is less than $76 R^2$ with R the separation distance in meters. See Verizon Comments at 4, Appendix A Verizon uses the same formula as the Commission, including 100 percent reflection, but incorporates the IEEE Std C95.1-2005 spatial peak power density value of 40 W/m^2 between 400 MHz and 3 GHz to calculate an ERP threshold of $76 R^2$. *Id.*; see also *AT&T Comments* (AT&T provides an example of a base station transmitter that would be exempt under the current rules but would no longer be exempt under the proposed rules, agreeing with WIA and Verizon and supporting their proposal for a modified exemption formula where access is controlled); CTIA Reply at 33-35 (arguing that small cell sites present little or no risk).

¹⁵³ See WIA Comments at 4; Verizon Reply at 2-4.

¹⁵⁴ WIA and Verizon’s proposed alternative formula that would take into account additional relevant characteristics of the antenna and the site will result into a formula that more closely resembles the evaluation rather than the exemption process.

¹⁵⁵ See *1996 Order*, 11 FCC Rcd at 15157, para. 89 (discussing that some transmitting facilities, regardless of service, may pose exposure concerns above MPE limits because high operating power, location or relative accessibility and use of such variables that apply generally to all transmitting facilities); *Id.* at 15158, para. 91 (discussing high operating power transmitters may need to be evaluated if certain conditions apply, such as when workers or the public could have access to the transmitter site, supporting need for routine evaluation)

¹⁵⁶ See *Second Memorandum Opinion and Order and Notice of Proposed Rulemaking*, 12 FCC Rcd at 13534, para. 104. The Commission replaced the term “rooftop” with the term “building-mounted” in its rules “to make it clear that our [exemptions from RF exposure routine evaluation requirements] apply to transmitters mounted on the sides of buildings as well as those mounted on building roofs . . . [to] remove possible confusion in the existing rules and . . . avoid potential situations where persons could be exposed to RF emissions in excess of our guidelines.” *Id.*

¹⁵⁷ See Verizon Comments at 4.

as a utility pole, may not be publicly accessible, adjacent spaces, like sidewalks, yards, or rights-of-way, may be accessible, rendering the transmitter appropriate for evaluation.¹⁵⁸ Although small cells and DAS transmitters may not be exempt under our new rules, the necessary determination of exemption or evaluation can be done simply and inexpensively. In the typical case of a structure as suggested by Verizon, the appropriate placement of the antenna can provide the basis for an exemption and can be readily replicated for other structures.¹⁵⁹ For a typical building- or roof-mounted antenna or a directional antenna, a routine evaluation can often take into account relevant characteristics of the antenna and the site to demonstrate compliance through a simple calculation. Our ongoing policy to consider other methods and procedures if based on sound engineering practice does not preclude other more complex procedures which sufficiently demonstrate compliance, such as performance of an RF exposure evaluation using the methods similar to those WIA and Verizon have proposed. We acknowledge that in some cases the simplicity of the exemption provisions may require an evaluation that would not be required if the formula was more complex. We conclude, however, that we have struck the right balance between simplicity, accuracy, and ensuring safety, as well as between requiring more complex analysis in all cases and requiring it in only a small percentage of cases. Further, we find that Verizon's alternative formula is based on inappropriate assumptions,¹⁶⁰ and cannot ensure compliance with the Commission's RF exposure limits.

¹⁵⁸ Verizon Comments at 3-7; WIA Reply at 2, 3. While Verizon's analysis purports to demonstrate that the maximum spatially-averaged exposure at ground level would be 17.1 percent of the Commission general population/uncontrolled limit and a similar analysis at the height of the antenna gives a maximum exposure of 57.1 percent of the limit, this analysis was performed with the minimum transmitter power and minimum antenna gain for small cells—a best case, rather than a worst case (or even typical case). See Verizon Comments at Appendix B. It is not apparent that realistically higher power and/or gain would not cause exposure over the limit. As Verizon itself shows, its proposed exemption formula gives a potential ERP threshold for an occupant of the example phone booth of 44.13 watts which is 4.413 times greater than the 10 watt ERP used in its calculation; resulting in a calculation of exposure that is 252 percent of the general population exposure limit at the height of the antenna and up to 75.5 percent spatially averaged at ground level, suggesting a significant risk of excessive exposure in the space occupied by a body (*i.e.*, appreciably above ground level). See *id.* (The ERP ratio of 4.413 (from 44.13 W/10 W) times 17.1% and 57.1% gives 75.5% and 252%, respectively.).

¹⁵⁹ For example, if calculation determines that for a particular transmitter power and antenna type, the closest location at which the exposure limit is exceeded is X, installation elements that assure the antenna distance exceeds X can be repeatedly used without further assessment of each site.

¹⁶⁰ Verizon's alternative formula assumes inappropriately that reflections cause only peak field exposure and it uses IEEE (2005) peak field limits while ignoring both the IEEE and the Commission's whole-body exposure limits. The Commission's rules do not set a relaxed limit on spatial peak power density. Even a simple free-space (without reflection) calculation shows that, accepting Verizon's proposed change, the formula would allow a uniform power density over the body (independent of distance R) to considerably exceed the Commission's general population exposure limit; for example, at 400 MHz, it would exceed the limit almost 4 times (a factor of 3.72). (See OET Bulletin 65 eq. (5), $S = 1.64 \text{ ERP}/4\pi R^2$, inserting Verizon's formula of $\text{ERP} = 76 R^2$ gives a constant power density of $S = 9.92 \text{ W/m}^2$ and the Commission general population/uncontrolled limit at 400 MHz is $S = 2.67 \text{ W/m}^2$ ($9.92/2.67 = 3.72$) and rises to 10 W/m^2 at 1500 MHz.) While this overage would be smaller at higher frequencies, it does not consider reflections, which would increase exposure beyond that calculated for free-space. As for spatial field variations, Verizon's argument that reflections only result in partial body exposures is not valid. For example, in the case of an individual standing between a vertical reflector (*e.g.*, a wall with metallic elements or a large metal appliance or pole) and a transmitting antenna, the electric field at one-quarter wavelength and continuing at one-half wavelength intervals from the reflector could be doubled (with 4 times the equivalent power density) and uniform as measured over a vertical line – a standard method for spatial averaging. Verizon fails to account for such vertical reflectors and resulting spatially-averaged field enhancements, which are particularly relevant at urban wireless facilities as powers increase and antennas continue to be installed on and adjacent to buildings.

2. Exemption Criteria - Multiple RF Sources

55. In this section, we address how to treat multiple RF sources in determining whether they are exempt from routine RF exposure evaluation. We adopt a modified version of our 2013 proposals describing the appropriate summation formulas and the circumstances in which they apply.¹⁶¹

a. 1-mW Exemption

56. For multiple RF sources inside a single device,¹⁶² each of which is capable of no more than 1 mW, we adopt a minimum 2-cm separation distance between antennas that operate in the same time-averaging period, as proposed in the *2013 RF Further Notice*.¹⁶³ In other words, if there are two or more RF sources inside a single device operating at the same time and the nearest parts of the antenna structures are separated by less than two centimeters, the 1-mW exemption will not apply. However, if the sum of multiple sources that can operate at the same time is less than 1 mW during the time-averaging period, they may be treated as a single source (separation is not required), and exempted accordingly. As with the exemption for a single RF source, this exemption cannot be used in conjunction with other exemption criteria, and medical implant devices may use only this 1-mW exemption. The record reflects that, based on these separation distances, emissions from multiple RF sources at no more than 1 mW power each would fall safely under our existing RF exposure limits, which we do not disturb today.¹⁶⁴ Therefore, we conclude that a blanket exemption, rather than case-by-case evaluation, is appropriate.

b. Use of Summation Formulas

57. In situations where RF exposure is generated from multiple sources at the same time, all such sources are considered in the aggregate to determine compliance with the exposure limits. The SAR- and MPE-based exemptions may be used along with known existing exposure levels to exempt multiple RF sources.¹⁶⁵ This is accomplished by normalizing each source power level to each matching exemption threshold power and determining whether the total of all the normalized powers¹⁶⁶ is no more than 1, meaning the summation of the percentages of the threshold from each RF source involved is no more than 100 percent of the threshold for the given exposure conditions. In addition, if pre-existing exposure levels are known, they may also be normalized to the exposure limits to determine the remaining margin for exemption of additional sources to demonstrate compliance with the limit. These concepts are applied to the antennas of multiple transmitters in a single device and to multiple fixed transmitters, as explained below.

(i) Multiple RF Sources with Fixed Physical Relationship

58. Typical devices today contain several transmitters and radiating antennas, some of which can operate at the same time. To address these various exposure conditions, we adopt the single

¹⁶¹ *2013 RF Order and Notice*, 28 FCC Rcd at 3544-47, paras. 139-44, 3550-54, paras. 154-65.

¹⁶² See 47 CFR § 2.1 Terms and definitions. *End Product*. A completed electronic device that has received all requisite FCC approvals and is suitable for marketing.

¹⁶³ *2013 RF Order and Notice*, 28 FCC Rcd at 3538, para. 121, 3555, para. 168.

¹⁶⁴ See Motorola Comments at 4; Medtronic Comments at 3; Wi-Fi Alliance Comments at 3; Wi-Fi Alliance Reply at 11.

¹⁶⁵ See *infra* Appx. A, Amended Rule 47 CFR § 1.1307(b)(1)(ii).

¹⁶⁶ Normalization here means dividing an RF source power level by the corresponding exemption threshold power; if the result is less than 1 for a single source, then that source is exempt. For example, if the source power is 30 W and the exemption threshold is 40 W, the normalized power would be 0.75, which is less than 1, so the single source would be exempt. If a second source is at 0.14 of its exemption threshold, the two together will sum to 0.89 of the threshold, which would be an exempt 2-transmitter installation. If an existing exposure is known to be (by calculation or measurement) 0.10 of the limit, the total is still 0.99 and the facility is exempt.

summation formula below for all RF sources, regardless of whether portable, mobile, or fixed, which has been modified since our 2013 proposals which provided for different formulas for portable, mobile and fixed transmitters, to combine these disparate efforts into a single formula for more general applicability.¹⁶⁷ For sites or devices with multiple transmitters, the summation formula shown below will determine whether multiple transmitters using the single transmitter formulas are collectively exempt from evaluation. This formula includes three summation terms, the first two of which are summations for the exemptions, the third is to account for exposure from existing evaluations, which we will describe in more detail below.

59. To quantitatively exempt any new or modified transmitter in a device or at a multiple transmitter location,¹⁶⁸ one must add the contribution of each source expressed as a percentage of the allowable maximum and those percentages must add up to no more than 100 percent of the allowance in the applicable formulas in Table 1 or Table 2 above, as expressed by this formula:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where

- a = number of fixed, mobile, or portable RF sources claiming exemption using the Table 1 formula for P_{th} , including existing exempt transmitters and those being added.
- b = number of fixed, mobile, or portable RF sources claiming exemption using the applicable Table 2 formula for Threshold ERP, including existing exempt transmitters and those being added.
- c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance.
- P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).
- $P_{th,i}$ = the exemption threshold power (P_{th}) according to the Table 1 formula for fixed, mobile, or portable RF source i .
- ERP_j = the available maximum time-averaged power or the ERP, whichever is greater, of fixed, mobile, or portable RF source j .
- $ERP_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source j , at a distance of at least $\lambda/2\pi$, according to the applicable Table 2 formula at the location in question.
- $Evaluated_k$ = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation.

¹⁶⁷ In 2013 we proposed different formulas for summing multiple fixed transmitters (2013 RF Order and Notice, 28 FCC Rcd at 3544-46, paras. 139-141), multiple portable transmitters (2013 RF Order and Notice, 28 FCC Rcd at 3550-52, paras. 154-160), and multiple portable and mobile transmitters (2013 RF Order and Notice, 28 FCC Rcd at 3552-54, paras. 161-165), all with similarly defined terms, appearing in multiple places in the proposed rules (2013 RF Order and Notice, 28 FCC Rcd at 3601, App. B). This decision here combines these duplicate parallel summation processes into a single formula generally applicable across any sum of multiple exempt RF sources, as applicable. The combined formula does not affect the results of any of the 2013 proposals, rather it reduces the number of possible paths in summing the exemptions of RF sources by broadening the applicability of a single formula across multiple use cases.

¹⁶⁸ Multiple transmitters using the same physical antenna should be treated as multiple antennas at the same location.

Exposure Limit_k = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable sources, as applicable.¹⁶⁹

60. The normalized contributions to the total exemption threshold can be determined by calculating for each RF source, whether mobile, portable, or fixed, the ratio of the maximum time-averaged power (matched conducted power or ERP, as appropriate) for the transmitter, comparing it to the appropriate frequency- and distance-dependent threshold using the formulas in either Table 1 or Table 2, and summing those ratios. If the ratios for all transmitters in a device operating in the same time-averaging period are included in the total sum and this sum is no more than one (*i.e.*, 100%), the cumulative contributions would not have exceeded the permissible limit and a location at a site or the device (*i.e.*, all transmitters within the device) would be exempt from routine evaluation.¹⁷⁰ All transmitters must be considered and all transmitters that can operate at the same time must be included in the summation of multiple transmitters. If a transmitter is subsequently proposed to be added under our permissive change authorization procedures for portable or mobile devices, a new calculation must be made including the additional transmitter.

61. The basic exemption criteria are contained in the *P* and *ERP* summation terms, while the *Evaluated/Exposure Limit* sum accounts for the preexisting exposure levels and correspondingly reduces the allowable margin remaining for exemption at the location of interest.¹⁷¹ For multiple antennas operating in the same time-averaging period, the summation formula above¹⁷² will apply as follows: sum the normalized contributions to the exemption threshold for each antenna by calculating the ratio of the maximum time-averaged P_i or ERP_j for the antenna to the corresponding exemption threshold $P_{th,i}$ or $ERP_{th,j}$, and then, summing these ratios, add any normalized contributions from RF sources with known exposure, (*i.e.*, the percentage of the relevant exposure limit that exists prior to considering the subject source(s)) at a specific location. If the total does not exceed one, the configuration is exempt.

62. Only Medtronic commented on the exemption summation proposal for portable or mobile devices, supporting the proposal but requesting that the Commission incorporate further technical definitions into its rules for terms used in the formula beyond those explicit in the *2013 RF Further Notice*. In particular, Medtronic requests definitions for the power quantities “maximum time-averaged ERP,” “available maximum time-averaged power,” and “delivered maximum time-averaged power.”¹⁷³ The use of maximum time-averaged power requires that the power (and corresponding maximum exposure) of multiple transmitters operating in the same time-averaging period be summed even if they do not transmit at the same instant (with or without overlapping transmissions) using the formula above. Because the exemptions rely on determination of available maximum time-averaged power and ERP, we are including definitions of “available maximum time-averaged power,” “effective radiated power (ERP),” and “time-averaging period” in the rules. However, because our exemptions do not rely on delivered power but available power, we decline to adopt a definition for “delivered maximum time-averaged power,” but we clarify here that the definition would be the largest net power delivered or supplied to an antenna, as averaged over a time period not to exceed 30 minutes for fixed sources, or as averaged over a time period inherent from the device transmission characteristics for mobile and portable sources (also not to exceed 30 minutes).

¹⁶⁹ See 47 CFR § 1.1310.

¹⁷⁰ The sum of the quotient(s) of each absorbed power, ambient power density, or field strength squared and their respective SAR(s) or MPE(s) limit(s) for a particular frequency, also commonly referred to as “fraction of standard.” Note that this last summation term is due to RF sources not included in the exemption summations.

¹⁷¹ For example, for mobile RF sources, this location of interest would typically be at a separation distance of 20 cm.

¹⁷² See *supra* para. 59.

¹⁷³ See *2013 RF Order and Notice*, 28 FCC Rcd at 15166, para. 112 & nn.190-92.

63. Medtronic also suggests that short time-averaging periods for non-overlapping transmission should be included in the rules.¹⁷⁴ We agree and further clarify that multiple source summations require time averaging over an averaging period during which the maximum power is being transmitted. These clarifications account for simultaneous transmissions while allowing for short time-averaging periods for non-overlapping transmissions,¹⁷⁵ provided that summations (or measurements) performed using a shorter time-averaging period correspond to the maximum aggregate time-averaged SAR or power density of the multiple transmitters being summed (*i.e.*, accounting for maximum duty cycle, maximum transmitted power, overlapping transmission, etc.). Also, short time-averaging periods (*e.g.*, over one pulse at maximum power) may be selected to conservatively determine power and avoid the need to sum powers from multiple transmitters when transmissions from the different transmitters do not overlap in time. The values for P_i , ERP_j , and $Evaluated_k$, where applicable, are determined according to the source-based time averaging requirements of Sections 2.1093(d)(5) and 2.1091(d)(2), and the sum of those values represents conservatively the total calculated exposure. This summation formula may be used even if some of the three terms do not apply (*i.e.*, where those terms would be zero). As the extent of overlapping transmissions may vary among individual products and host configurations, applicants may want to consult device-specific procedures developed by the FCC Laboratory addressing the details of how to perform evaluations and determine compliance.¹⁷⁶

64. There were relatively few other comments directly addressing the proposed summation formula for the exemption of multiple fixed transmitters. While it did not object to the formula, Verizon considered each of the methods/summation terms as representing an independent method to determine exemption and suggested that different methods could be used for different sources, as appropriate, in determining the contribution of individual transmitters at a multiple transmitter site.¹⁷⁷ In response, Boston & Philadelphia argued that, in the interest of simplicity and consistency, all wireless providers at any particular site should agree upon a single method.¹⁷⁸ Motorola commented that the Commission should be clear that a single transmitter should only be counted once in the summation formula.¹⁷⁹ H&E presumed that measurements were required to establish the evaluated summation term and suggested simply measuring the actual exposure to avoid the possibility of counting a single source more than once.¹⁸⁰ In the modified exemption summation formula we adopt here, which differs from our 2013

¹⁷⁴ See Medtronic Comments at 5-6.

¹⁷⁵ See 2013 RF Order and Notice, 28 FCC Rcd at 3502, para. 8 & n.10 (“Exposures due to multiple transmitters are considered ‘simultaneous’ if these exposures occur in the same time averaging period. For example, for two variable power consumer transmitters averaged over the same source-based time averaging period, the exposure based on the time-averaged SARs must be summed even though either transmitter may not necessarily be transmitting at the same instant. In principle, time averaging periods up to 30 minutes could be required; however, shorter time averaging periods less than 30 minutes are permitted, and in fact are required for mobile and portable consumer devices, to avoid redundant or repetitive measurements, provided that measurements performed using a shorter time averaging period result in the maximum aggregate time-averaged SAR of the multiple transmitters being summed (*i.e.*, accounting for maximum duty cycle, maximum transmitted power, overlapping transmission, etc.). Alternatively, short time averaging periods (*e.g.*, over one pulse at maximum power) may be selected to conservatively measure SAR and avoid the need to sum SARs from multiple transmitters during non-overlapping transmission.”).

¹⁷⁶ See *infra* Section V.C, Transmitter-Based and Device-Based Time-Averaging (we seek comment on how applications of these exemption criteria and accounting for overlapping transmissions and time-averaging periods might be either similar or different in the context of transmitter/device-based time-averaging).

¹⁷⁷ See Verizon Comments at 8-9.

¹⁷⁸ See Boston & Philadelphia Reply at 5.

¹⁷⁹ See Motorola Comments at 7.

¹⁸⁰ See H&E Reply at 3.

proposal, we address commenters' concerns by making each term in the consistently applied summation approach representative of either one of the independent methods of exemption or an evaluation. We emphasize here that parties who may wish to apply different reasonable summation methods may do so, but such methods would not be considered as an exemption as described in our rules; instead, an alternative summation approach that appropriately demonstrates compliance would be considered a routine RF exposure evaluation.

65. We find that there is no reason or circumstance for which a transmitter should be counted more than once in the overall sum for any particular exposure location. At a proposed site with higher-power fixed transmitters, only the *ERP* summation terms would normally be used. At an existing site with known exposure levels, the *Evaluated* third term in the total sum would appropriately reduce the margin for (any new) transmitters claiming *ERP* exemption. This should be most useful when a fixed transmitter is being added to a dense antenna facility. Where existing exposures collectively are not significant,¹⁸¹ the *Evaluated* third term in the summation may be disregarded.¹⁸² For low-power fixed transmitters, the *P* exemption summation term will typically be less restrictive where applicable than the *ERP* exemption term and the margin would be reduced where necessary based on existing SAR evaluation data. The *P* and *Evaluated* terms may be most commonly used in situations where, for example, multiple transmitter modules are installed in a small device. As far as the discussion by commenters of various summation methods, the method we adopt is simple, consistent, and conservative. In addition, just as the methods for determining exemption from routine evaluation are not the only means to demonstrate compliance with the RF exposure limits, other more sophisticated methods of adding contributions from multiple transmitters are acceptable if based on sound engineering practice, but these alternative procedures would be considered as part of an RF exposure evaluation demonstration rather than an exemption.

(ii) RF Sources without Fixed Physical Relationships

66. In determining the availability of an exemption, we will not require applicants to account for multiple RF sources that have no fixed positional relationship between or among each other, as is typically the case between a mobile and a broadcast antenna or other fixed source or between two mobile sources.¹⁸³ There is no practical method to quantitatively establish exemption for multiple RF sources where there is no definite positional relationship between sources, such as between multiple mobile/portable devices or between such devices and fixed transmitters. None was recommended by commenters.

67. While certain commenters raised concerns about the effect of cumulative RF exposure, we find that consideration of the typical spatial separation between RF sources diminishes the practical relevance of multiple spatially uncorrelated transmitters.¹⁸⁴ Exposure from fixed RF sources will vary

¹⁸¹ See 47 CFR § 1.1307(b)(3) ("In general, when the guidelines specified in § 1.1310 are exceeded in an accessible area due to the emissions from multiple fixed transmitters, actions necessary to bring the area into compliance are the shared responsibility of all licensees whose transmitters produce, at the area in question, power density levels that exceed 5% of the power density exposure limit applicable to their particular transmitter or field strength levels that, when squared, exceed 5% of the square of the electric or magnetic field strength limit applicable to their particular transmitter.").

¹⁸² *Id.* Greater than 0.05 (5%) is considered significant.

¹⁸³ See 2013 RF Order and Notice, 28 FCC Rcd at 3546-47, paras. 142-44.

¹⁸⁴ B. Blake Levitt & Henry C. Lai (Levitt/Lai) Comments at 14; Hubert Comments at 3 (expressing concern about the cumulative effect of exposure from many sources even where the total exposure is far below our exposure limits). Further, Sections 1.1307(c) and (d) of the Commission rules require further environmental processing if the staff determines, on its own or based upon the allegations of an interested party in a written submission, that the particular use of a device ordinarily exempt from RF exposure routine evaluation exceeds the applicable exposure limits.

considerably in different environments that contain a portable or mobile device, depending on location relative to that fixed RF source. Additionally, since exposure diminishes exponentially with increasing distance, signal losses occur due to non-line-of-sight conditions from distant sources, and separation from fixed sources is typically large, exposure from fixed RF sources is normally much less than the limit and contributes negligible exposure virtually all the time, and we expect that exposure from devices near a person's body would generally be overwhelmingly more significant. More simply, we expect that the locations of maximum SAR in the body from different RF sources that are proximate to the body are highly unlikely to overlap, precisely because when the RF sources are close to the body they will be exposing smaller areas of the body and separated sources will accordingly expose different areas of the body without overlap. We conclude that for these reasons, the summation of potential exposure due to spatially uncorrelated sources should not be routinely required and our conclusion is consistent with all known compliance activities to date.

68. Also, we note that the exposure from each portable or mobile device near a person will generally involve low total power absorption while being highly localized and will not result in significant contributions to whole-body average SAR. Thus, for multiple exempt RF sources without an inherent spatial relationship, regardless of their classification as fixed, mobile, or portable, it is very unlikely the localized or whole-body SAR limits would be exceeded.¹⁸⁵

B. Environmental Evaluation

69. For fixed RF sources where an exemption cannot be invoked, a routine environmental evaluation—described in our rules as a “determination of compliance”—must be performed to ensure that the exposure limits are not exceeded in places that are accessible to people. In the great majority of cases, such an evaluation is simple and generic and does not require a determination of the precise exposure level, only that it can be determined from the information available that any potential of RF exposure is less than our limits. In other cases, the evaluation may be more complex, requiring more precision with regard to transmitter power and antenna distance from a space that persons can access. In such cases, the benefit of protecting humans from RF emissions causing exposures in excess of our existing limits outweighs the costs that may be associated with such evaluation.

70. The rapidly evolving technology of mobile and portable devices and the evaluation and testing technology associated with RF exposure of such devices require that the equipment authorization process be updated to reflect such changes. As proposed in the *2013 RF Further Notice*, we remove from our rules provisions that specify acceptable approaches to evaluation and will instead allow any valid computational method to be used in demonstrating compliance with our RF exposure limits.¹⁸⁶ OET Bulletins and the KDB will describe acceptable methods for particular applications, and applicants can request use of other computational or measurement methods whose reliability and validity they can substantiate to the satisfaction of OET staff.¹⁸⁷ As proposed,¹⁸⁸ we also eliminate a minimum measurement distance of 5 cm for devices operating above 6 GHz, since this requirement appears to have been rendered obsolete by technological developments and is no longer necessary.¹⁸⁹

¹⁸⁵ No commenter suggested any way, practical or not, to determine when and how to exempt sources for such situations.

¹⁸⁶ See *2013 RF Order and Notice*, 28 FCC Rcd at 3555, para. 168. The relevant sections to be amended are 47 CFR §§ 1.1307(b)(4)(iv), 95.1221.

¹⁸⁷ 47 CFR § 2.947(a)(3).

¹⁸⁸ See *2013 RF Order and Notice*, 28 FCC Rcd at 3556, para. 170.

¹⁸⁹ See *infra* para. 73.

1. Consistency in Usage of Any Valid Method for SAR Computation

71. We adopt our proposal to modify the language in sections of our rules¹⁹⁰ to allow any valid computational method by removing specific references to finite difference time domain (FDTD).¹⁹¹ In the 2013 *Order*, the Commission corrected an inconsistency in the rules to allow either computation or measurement for medical devices in both sections 95.1221 and 1.1307(b)(2) of our rules, but continued to require the FDTD method when computation is used.¹⁹² In the 2013 *RF Further Notice*, we proposed to allow any valid computational method by removing from our rules the reference to this specific method.¹⁹³ To ensure validity, our rules will require that computational modeling be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated.¹⁹⁴ In addition, the equipment under test and exposure conditions must be modeled according to protocols established by FCC-accepted numerical computation standards or available FCC procedures for the specific computational method.”¹⁹⁵

72. Most parties support this specific proposal to allow numerical methods other than FDTD, and we continue to find that this is the appropriate rule.¹⁹⁶ B. Blake Levitt and Henry C. Lai (Levitt/Lai), who focus on fixed sites, propose an increased reliance on field measurement rather than computation, expressing concern that SAR computation would underestimate exposure, but do not provide an empirical basis for this assertion.¹⁹⁷ In our experience, computational methods for transmitter facilities are generally more restrictive than measurements because computations typically use maximum power and other conservative assumptions. Therefore, actual measurements often result in lower exposure values due to these conservative assumptions often employed in computational methods, but using maximum power and other conservative assumptions can provide a simpler, less burdensome means of demonstrating compliance and will continue to be permitted where they can be successfully supported.¹⁹⁸ Medtronic supports our proposal but also seeks clear guidance for software developers about the requirements for valid software.¹⁹⁹ OET will continue to update the KDB to provide appropriate guidance on acceptable methods of computation with accepted numerical computation standards or procedures for specific computational methods.

¹⁹⁰ While we adopt our proposal to modify the language in Section 95.1221, as they appeared in the 2013 *RF Order and Notice*, we note that some of those rule numbers have changed in the interim (e.g., the Part 95 rules were renumbered as part of the 2017 *Report and Order*). The numbers modified hereby are identified in Appendix A. See §§ 1.1310(d)(1), 2.1093(d)(2), and 95.2585, Appendix A *infra*.

¹⁹¹ See *Order granting ANSYS Inc. Request for Waiver of 47 CFR § 1.1307(b)(2) of Commission Rules*, ET Docket No. 10-166, Order, 26 FCC Rcd 1034 (2011).

¹⁹² See 2013 *RF Order and Notice*, 28 FCC Rcd at 3517, para. 51 (2013).

¹⁹³ See *id.* at 3555, para. 168.

¹⁹⁴ Fully validated means that a method has been tested and shown to provide results equivalent to those derived from already accepted methods for the same canonical device(s). See also CDE Comments at 2. As cautioned by CDE, we will require that to be valid, any SAR computation method must be clearly documented and shown to produce consistent results

¹⁹⁵ See *infra* Appx. A; see also 47 CFR §§ 1.1310, 2.1093(d)(1).

¹⁹⁶ See TIA Comments at 22 (supports the proposal and endorses the use of IEEE and IEC standards for validation of computational methods); Medtronic Comments at 6; CDE Comments at 2.

¹⁹⁷ See Levitt/Lai Comments at 7 and 29.

¹⁹⁸ In the case of a dispute or a credible concern, in practice, the ultimate determination of compliance will continue to be based on FCC measurements.

¹⁹⁹ See Medtronic Comments at 6.

2. Removal of Minimum Evaluation Distance Requirement from Rules for Frequencies above 6 GHz

73. In the *2013 RF Order and Notice*, we proposed²⁰⁰ to remove the 5-cm minimum separation specification for measurements and calculations used to demonstrate compliance for devices operating above 6 GHz from Section 2.1093(d) of our rules.²⁰¹ We adopt our proposal. The 5-cm minimum separation distance has been superseded by technological developments that provide for uses with transmitting elements closer to the body, and to the extent any portable devices are operating above 6 GHz, the measurement distance should be reflective of normal use conditions. Consumers for Safe Cell Phones (CSCP) supports the proposal as one that will better simulate RF exposure in typical situations,²⁰² and we draw the same conclusion. Applicants must provide specific justification for measurement distances used in compliance testing, describing the normal and feasible usage(s) of the device, and certification review will specifically include evaluation of the propriety of this specification, including any measures that may be taken to ensure that it is maintained.

3. Technical Evaluation References in Rules

74. In the *2013 RF Order and Notice*, we included in our rules a reference to the OET KDB in place of a specific (now outdated) external technical reference to IEEE Std C95.3-1991 as a possible SAR evaluation reference.²⁰³ In doing so, we committed to providing ongoing guidance on technical evaluation procedures and standards. In the *2013 RF Further Notice*, we proposed to remove external technical evaluation references elsewhere within our rules generally, and to specifically remove reference to IEEE Std C95.3-1991 in Section 24.51(c).²⁰⁴ We adopt that proposal.

75. There remains general support for providing ongoing policy guidance consistent with advances in the engineering state of art of the field in the KDB rather than specifying specific standards in the Commission's rules. Like the OET Bulletins, the guidance in the KDB is not binding on the applicant or the Commission, and other evaluation methods may be used if they can be shown to be valid. We also recognize that expedited approval of devices by Telecommunications Certification Body (TCB) necessarily involves the use of uniform evaluation procedures as established using the KDB.²⁰⁵ As such,

²⁰⁰ *2013 RF Order and Notice*, 28 FCC Rcd at 3556, para. 170.

²⁰¹ See 47 CFR § 2.1093(d) (requiring a minimum separation distance of five cm for measurements and calculations used to demonstrate compliance for devices operating above 6 GHz). With the development of portable devices such as notebook and tablet computers with wireless modules transmitting in the 60 GHz frequency range, it is possible that these devices will be used close to the body. In such cases, we have required measurements at closer distances where usage indicated that this is a more realistic representation of the exposure distance, see FCC ID: PD918260NG (wireless module installed in a notebook computer), and FCC ID: PD918265NG (wireless module installed in a tablet computer). There has been substantial improvement in applying numerical simulation techniques for RF exposure over the last two decades, which is useful for close-in determinations, and applicants for equipment authorization have successfully applied a combination of numerical simulation and measurement methods to determine power density at these distances to demonstrate compliance. Also, a miniature electric field probe supported by a SAR measurement system capable of making mmWave power density measurements up to approximately 90 GHz at 2 mm or more from wireless devices is now commercially available.

²⁰² See CSCP Comments at 2. No other party commented on this proposal.

²⁰³ See *2013 RF Order and Notice*, 28 FCC Rcd at 3510-13, paras. 28-41; see also 47 CFR § 2.1093(d)(3).

²⁰⁴ See *2013 RF Order and Notice*, 28 FCC Rcd at 3556-57, paras. 173-74.

²⁰⁵ See 47 CFR § 2.907. Under Section 302(e) of the Communications Act, 47 U.S.C. § 302a(e), the Commission is authorized to delegate its equipment testing and certification functions to private organizations. In 1998, the Commission adopted rules allowing accredited TCBs to approve most types of equipment that require certification. *1998 Biennial Regulatory Review—Amendment of Parts 2, 25 and 68 of the Commission's Rules to Further Streamline the Equipment Authorization Process for Radio Frequency Equipment, Modify the Equipment Authorization Process for Telephone Terminal Equipment, Implement Mutual Recognition Agreements and Begin* (continued....)

we have already been successfully implementing the recommended procedural changes for KDB documents of general applicability.

76. This proposal received significant comment from Motorola, CDE, Nokia Corporation (Nokia), and Mobile & Wireless Forum (MWF).²⁰⁶ While Motorola supports use of the KDB for this purpose, it expressed some concerns about process and transparency, suggesting that the KDB has the potential to compromise notice-and-comment rulemaking process.²⁰⁷ Similarly, MWF and Nokia recommended a process for the development of KDB documents that would involve release of a draft with opportunity to comment, adequate transition period, harmonization to the extent possible with international standards and practices, and flexibility for innovation in both testing and technology.²⁰⁸ With respect to these suggestions, and as Motorola points out,²⁰⁹ the FCC Laboratory now issues draft versions of KDB guidance documents and engages manufacturers and other affected entities early in the revision process,²¹⁰ and that the guidance provides flexibility and the opportunity to harmonize FCC standards with existing standards where practical. These procedures effectively address commenters' concerns regarding process and participation, and the ongoing and responsive nature of the KDB should result in better "readability" and usability than rules we might otherwise adopt. And, we stress again, the KDB process consists of up-to-date expert guidance by our staff and is nonbinding, thus preserving the option of raising any concern or disagreement with the Commission.²¹¹

77. Commenters generally prefer the Commission's approach of providing guidance in the KDB as opposed to specifying it in the Commission's rules, although they note various ways that the KDB process could be improved. Motorola suggests that the Commission should consider improvements to the process, even as it acknowledges that OET has taken steps to engage the affected entities in the process of KDB revision and update in general.²¹² CDE suggests that the Commission maintain and update OET Bulletins 56 and 65 but keep the material readable for the public. CDE also expresses concern about process and content for the KDB, asking about what recourse there is in the case of doubts about KDB materials, the potential impact of future personnel or organizational changes on the quality of the KDB, and whether the material is useful and readable for the public at large.²¹³ At this time, we decline to address these suggestions for improvement of the KDB process.

78. We acknowledge the support of MWF and Nokia for the incorporation of international evaluation standards in the KDB and are mindful of the Office of Management and Budget (OMB)

(Continued from previous page) _____

Implementation of the Global Mobile Personal Communications by Satellite (GMPCS) Arrangements, GEN Docket No. 98-68, Report and Order, 13 FCC Rcd 24687, 24703, para. 32 (1998).

²⁰⁶ Formerly Mobile Manufacturers Forum (MMF).

²⁰⁷ See Motorola Comments at 8.

²⁰⁸ See MWF Comments at 3-4; Nokia Comments at 5-6.

²⁰⁹ See Motorola Comments at 8.

²¹⁰ See <https://apps.fcc.gov/oetcf/kdb/reports/PublishedDocumentList.cfm>; draft publications of the OET Laboratory Division are available at that website, including proposed guidance intended for KDB publication and tutorial presentations, along with means for submitting public comments. The public is invited to make comments and provide suggestions to the documents made available at this page. At the end of the comment period, revised documents may be published, withdrawn or modified and submitted for additional review.

²¹¹ Since the inception of the KDB process, the FCC Laboratory has issued myriad guidance documents on technical issues regarding equipment authorization. The Commission has not received any complaint regarding any of the guidance provided and or the process itself.

²¹² See Motorola Comments at 7-8.

²¹³ See CDE Comments at 4.

Circular A-119, which encourages federal participation in the development and use of voluntary consensus standards and in conformity assessment activities, to which they refer.²¹⁴ Contrary to Nokia's suggestion, we decline to implement a presumption in favor of the adoption of standards from a standards committee simply because Commission staff sit on that committee. While Commission staff has been and will continue to be involved in standards committees, its availability to participate is not constant, and when it does participate it would be premature to assume FCC validation of such standards. As stated in OMB Circular A-119, "agency participation in standards bodies does not connote agency endorsement or agreement with decisions by such bodies." In evaluating whether to use a standard, which is done on a case-by-case basis, an agency needs to consider several factors to determine if it is effective and otherwise suitable for meeting the regulatory needs of the Commission, including our review of it in light of notice and opportunity to comment. Further, we also modified our rules for measurement procedures to make it clear that "any measurement procedures acceptable to the Commission may be used to prepare data demonstrating compliance with the requirements of this chapter."²¹⁵

79. We agree that OET Bulletins 56 and 65 have been useful but need to be updated. To avoid confusion, we will eliminate Bulletin 56 in its present form in deference to more current material on the same subject on the Commission's website. The staff will maintain and update OET Bulletin 65 as a stand-alone document available for download.

C. Mitigation Measures to Ensure Compliance with Exposure Limits

80. While the purpose of evaluation is to establish whether there is a spatial region or area near transmitting antennas where the RF exposure limits are exceeded, the purpose of mitigation is to take the appropriate steps to keep persons out of that space. With the proliferation of wireless base stations that are increasingly smaller in size, sometimes concealed or camouflaged, and often located close to where persons pass, linger, or work, additional measures are needed to ensure that exposure in excess of our general population limits is permitted only for those with proper training and capability to limit their exposure. Such post-evaluation mitigation measures include labels, signs, markings, barriers, positive access controls, and occupational training.²¹⁶ Mitigation requirements depend on the physical characteristics of the area and the level of exposure above the pertinent limits. These measures range from precluding members of the general public from entering areas where exposure exceeds the general population continuous limit (general population / uncontrolled), to measures allowing only trained workers to enter an area that exceeds the continuous occupational limit either briefly, with protective clothing, or with an exposure monitor so that compliance with the occupational limit with 6-minute time averaging is maintained (occupational/controlled) environments. This pertains primarily to fixed sites; mitigation measures for mobile and portable devices are typically based on device features such as proximity sensors or device-controlled time averaging.²¹⁷

81. Our existing rules address mitigation in general terms but lack specificity about how to prevent access to spatial regions where the RF exposure limits are exceeded and what measures (i.e. access restriction, signage, and training) should be considered adequate. Given the proliferation of antennas, changes in siting practices, and our consequent experience and that reflected in the record as responses to our initial proposals in the *Notice*, the *2013 RF Further Notice* proposed specific access

²¹⁴ See https://www.whitehouse.gov/omb/circulars_a119/.

²¹⁵ 47 CFR §2.947(a)(3). The rules permit the use of any advisory information regarding measurement procedures that can be found in the KDB, but also permits parties to submit alternatives.

²¹⁶ *Positive access control* includes locked doors, ladder cages, or effective fences, as well as enforced prohibition of public access to external surfaces of buildings, or generally, affirmative physical measures for preclusion of unauthorized access. It does not include natural barriers, which might limit access effectively in some, but not all cases, or other access restrictions that did not require any action on the part of the licensee or property management.

²¹⁷ See *supra* para. 14; *infra* Section V.B.

restriction, signage, and training requirements for fixed transmitter sites where exposure limits may be exceeded, considering recent standards activity working toward defining industrial RF safety programs.²¹⁸

1. Transient Exposure

82. Currently, our rules provide that occupational exposure limits could apply to untrained persons, provided that the exposure is “transient” and they are informed of the exposure potential and the appropriate means to mitigate their exposure.²¹⁹ In the *2013 RF Further Notice*, we noted that these rules lacked the requisite clarity and could be interpreted in different ways.²²⁰ To address this, we proposed to define transient exposure as brief exposure in a controlled environment that does not exceed the general population limit, which may be averaged over a time interval up to 30 minutes long, and to limit transient exposure to the continuous occupational limit at any time.²²¹

83. We adopt our proposed definition of transient exposure as the brief exposure in a controlled environment that does not exceed the general population limit, which may be averaged over a time interval up to 30 minutes.²²² However, we do not adopt our proposal that transient exposure should not exceed the continuous occupational limit at any time.²²³ As H&E contends, our proposal to limit transient exposure above the occupational limit “at any time” would result in a more restrictive exposure limit for transient individuals than for the general public for which there is no temporal peak limit.²²⁴ Our present rules limiting exposure for all populations do not specify a cap at any peak value above the continuous limits.²²⁵ As long as the average exposure over any applicable time-averaged period provided in our rules is compliant with the continuous general population limit, a transient individual walking in a controlled area may be exposed above the general population limit in one location and below this limit in another location. Our rules do not specify how much above that general population limit an instantaneous exposure is permitted to be.

84. The National Association of Broadcasters (NAB) asserts that all aspects of occupational exposure should apply to transient persons, including the 6-minute averaging time applicable for occupational exposure.²²⁶ We emphasize here, however, that despite NAB’s interpretation, the time-averaging period for transient persons is up to 30 minutes, per our rules²²⁷ and per the NCRP Report cited

²¹⁸ Since the *2013 RF Order and Notice*, IEEE has produced a revised version of its 2005 standard, IEEE C95.7-2014, which closely matches our proposals.

²¹⁹ 47 CFR § 1.1310(e)(1).

²²⁰ See *2013 RF Order and Notice*, 28 FCC Rcd at 3557, para. 177 *et seq.*

²²¹ *2013 RF Order and Notice*, 28 FCC Rcd at 3558, para. 181.

²²² Numerous commenters expressed support for the adoption of the proposal. See Portland Comments at 4; UTC Reply at 7; Boston Reply at 6.

²²³ Our continuous *exposure limits* are the values listed in 47 CFR § 1.1310 without consideration of averaging time and may not be exceeded over an indefinite period of time but may be exceeded over shorter definite time periods given consideration of time averaging. The continuous exposure limits are generally used to define the boundaries of controlled areas where “behavior-based” time averaging may be necessary. We generally refer to simply the “exposure limit,” when “behavior-based” time averaging is not considered.

²²⁴ See H&E Reply at 3.

²²⁵ See SiteSafe Comments at 2; H&E Reply at 3; Tell Comments at 2 (arguing against limiting transient exposure to the continuous occupational limit at any time, as it would make the Commission’s interpretation of transient exposure limits in the *2013 RF Order and Notice* more restrictive than the public exposure limits, by precluding peak levels in excess of the occupational limit even if the time-averaged level is below the public limit).

²²⁶ See NAB Comments at 5-7; 47 CFR § 1.1310(b), (e).

²²⁷ See 47 CFR § 1.1310(e), tbl. 1.

in our rules, which forms in part the basis of our exposure limits.²²⁸ As we stated previously, shorter averaging times can also be used during evaluation; while they are generally more conservative, they may provide convenience.²²⁹

85. Global RF Solutions (Global RF) expresses concern about the use of the term “general population” in conjunction with “controlled,” arguing that a person can be ‘Controlled’ or ‘Uncontrolled’ but not both.²³⁰ We are not convinced that these concerns over the terminology, and how it is applied, are valid. There are only two sets of limits—those which apply to supervised/trained workers (in an occupational setting) and those which apply to the general population (which includes unsupervised and untrained workers).²³¹ The environment in which these exposures occur defines whether the exposure is in a controlled or uncontrolled setting.²³² By definition, a controlled environment is an occupational setting. Because we are also adopting requirements for implementing RF safety programs at fixed sites, the only situation where transient exposure would be relevant is in a controlled setting.

86. The rules we adopt today will require, for controlled areas where the general population limit is exceeded, access controls and appropriate signage in addition to supervision of transient individuals by trained occupational personnel.²³³ NAB and Motorola Solutions, Inc. (Motorola) both argue that the Commission’s requirements that transient individuals be supervised are unnecessary, burdensome, and not practical or effective.²³⁴ We disagree. The supervision requirement is reasonable because it ensures that within a controlled area exposure above the general public limits is only transient. These new rules address the concerns of EMR Policy Institute (EMRPI) about making transient individuals aware when they enter (and leave) areas where exposure exceeds the general population limits.²³⁵ For the case of visitors to a controlled site, again, normal familiarization procedures, such as pointing out the meaning of RF signs and boundaries would constitute adequate awareness. Such activities could avoid exceeding the general population limit with time averaging during orientation while supporting an awareness so that occupational limits would apply to subsequent independent activity.

87. We find no basis for permitting exposure of any untrained individuals—regardless of whether they are workers—greater than the general population exposure limit. The applicability of occupational limits requires that a person is fully aware and able to exercise control over his or her work-

²²⁸ See NCRP Report No. 86, Section 17.4.3: *Time Averaging for the General Population*: “... the 30-min time-averaging period is responsive to some special circumstances for the public at large. Examples are transient passage by the individual past high-powered RFEM sources, and brief exposure to civil telecommunications systems.”

²²⁹ By applying a 30-minute time average to transient individuals, it is also theoretically possible for RF sources operating below 1.34 MHz that a transient individual could actually be permitted to be exposed to higher fields during some parts of a time period between 6 and 30 minutes than would a worker, because our occupational and general population limits are identical at these frequencies. We do not anticipate that this would occur in practice, however, especially given that RF safety programs designed for worker protection would normally be held to the continuous occupational exposure limit, but it reinforces the need for transient individuals to be supervised.

²³⁰ See Wessel Comments at 1-2.

²³¹ See NCRP Report No. 86, Section 17.4.1: *Occupational Exposure Criteria*, and Section 17.4.2: *General-Population Exposure Criteria*. “[I]ndividuals exposed in the work place should be relatively well informed of the potential hazards associated with their occupation. Furthermore, these workers may have the opportunity to make personal decisions in regard to their exposure, based on the relative risk as they perceive it. Individuals subjected to [RF exposure] outside the work place are generally unaware of their exposure, and furthermore, if they are aware, they rarely have the option to reduce their level of exposure.”

²³² See 1996 Order, 11 FCC Rcd at 15136, para. 35.

²³³ See *infra* Appx. A.

²³⁴ See NAB Comments at 7-8; Motorola Comments at 9 (questioning what qualifies as “supervision”).

²³⁵ See EMRPI Comments at 8.

related exposure.²³⁶ Thus, the occupational exposure limits apply only if a person has been trained and has sufficient information to be fully aware of the nearby RF sources and the necessity and means of avoiding overexposure. To satisfy the requirement to present written or oral information to untrained transient individuals within controlled environments, we affirm that written information may include signs, maps, or diagrams showing where exposure limits are exceeded, and oral information may include prerecorded messages.

88. RF Check contends that any workers, including contractors and employees of licensees, electricians, roofers, flashers, painters, HVAC personnel, maintenance workers, firefighters, and utility workers, who must perform any task or stop in an area that exceeds general population limits must not be considered transient and must be trained.²³⁷ OSHA shared similar concerns as they related to third-party workers who have not received training and may be unaware they are working near RF sources on rooftops and buildings.²³⁸ We agree with OSHA and RF Check that third-party workers who perform tasks near RF sources must be trained and are not considered transient. With rare exceptions, anyone who might enter an area where the general population limits are exceeded should have already received RF awareness training prior to accessing the area.²³⁹ As the NCRP Report provides, transient provisions are not to be used with any regularity and so would not apply to persons expected to be in locations for extended periods where the general population limits are exceeded (tree trimmers, window washers, etc.), nor to persons who traverse such an area on a regular basis, such as an employee parking lot or walkway; rather, all such persons must receive appropriate training.²⁴⁰

2. Signage and Access Control

89. There are various effective means to achieve compliance with the RF exposure limits. Those include signs, roof markings, barriers, exposure level maps, and positive access control. Under the rules we adopt today, signs are not required *per se* and not all signs are applicable to all services or situations. Specifically, we will require licensees and operators of fixed RF sources to use signs when the RF source or combination of RF sources in the same area create locations where exposure is above the limit for the general public. We also allow alternatively the use of indicators (*e.g.*, chains, railing, paint, and diagrams) as well as the option to affix signs directly to the surface of an antenna, particularly in situations where positive access controls are in place to effectively restrict access only to persons who are trained (*e.g.*, on a rooftop with a locked door) in areas within where the public limits are exceeded (Category Two and above).

²³⁶ See 47 CFR § 1.1310.

²³⁷ See SiteSafe Comments at 2; RF Check Comments at 2-4.

²³⁸ See Letter from William Perry, Director, Directorate of Standards and Guidance, Occupational Safety and Health Administration, to Julius Knapp, Chief, FCC Office of Engineering and Technology at 3, (July 1, 2015) (OSHA Letter).

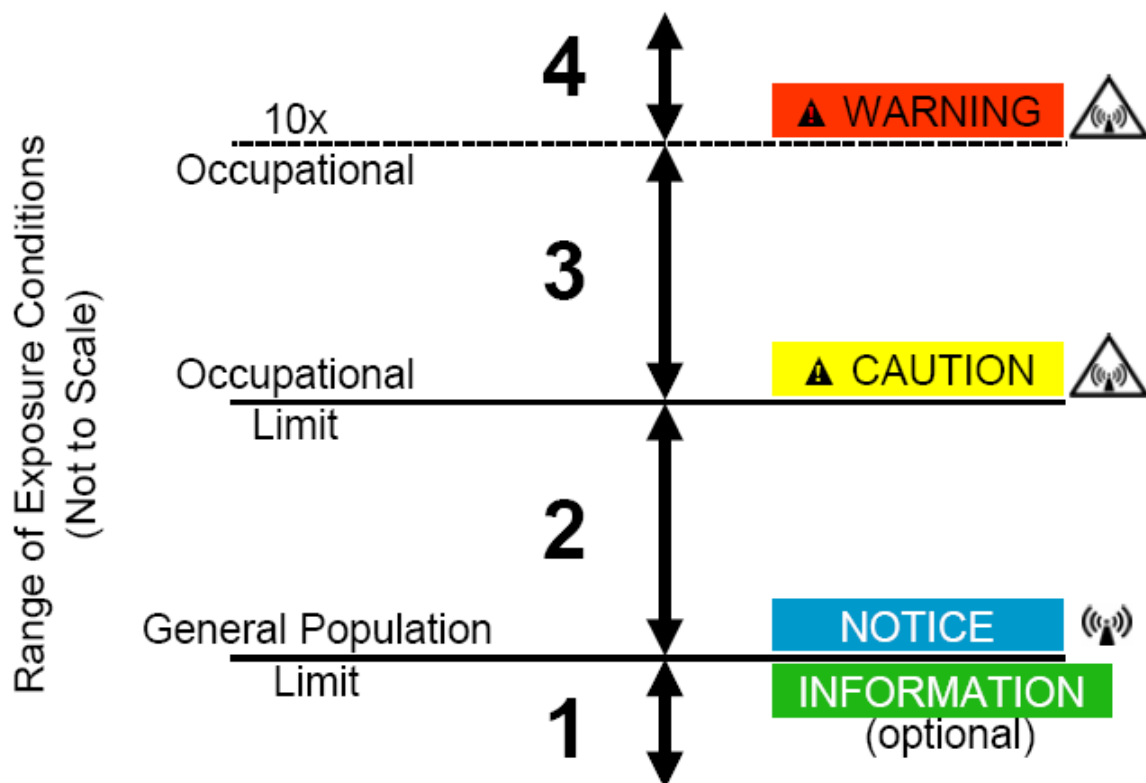
²³⁹ Although we are allowing a brief higher exposure coupled with control of some aspect of a transient person's behavior as a result of supervisory instruction that is given in such a way as to maintain compliance with the general population limit, it is the licensee's responsibility as part of its RF safety program to manage compliance in the event that persons (either trained or supervised) are permitted access to areas of their site with the potential to exceed the general population exposure limit.

²⁴⁰ See NCRP Report No. 86, Section 17.4.4: *Special Circumstances for Population Exposure*:


It is recognized that there are special circumstances in which the exposure limits for the general population may unnecessarily inhibit activities that are brief and non-repetitive. For example, the presence nearby of a number of emergency vehicles engaged in telecommunications might cause a brief exposure to fields at strengths above the general-population limit. Because only small groups of the population would be exposed under these conditions, and almost certainly not on a repeated basis, the occupational exposure levels are permitted for such cases.

90. We adopt four categories for specifying RF safety program actions, as proposed, *i.e.*, *Category One* through *Category Four*, which reflect the potential RF exposure scenarios. For a visual depiction of these categories, refer to Figure 1 below.²⁴¹

Figure 1. Graphical Representation of Exposure Categories and Associated Signage Requirements



NOTE 1: Where immediate and serious injury would occur on contact regardless of category,

⚠ DANGER  the following sign components are required pursuant to the description of *Category Four* in paragraph 91.

NOTE 2: Drawn from IEEE Std C95.7-2014 and IEEE Std C95.2-1999.

91. Determination of the appropriate Category Two, Three, or Four signage must be based on a specific site evaluation, consistent with our existing recommendations and rules for routine evaluation of compliance by measurement or computation.²⁴² The standardized signage we adopt in this *Order* is intended to apply to all exposure situations in which they are used, so that when signs are used they conform to the specification provided in this *Order*. The following information must be included in a sign, in addition to those specifically identified per each category level below:²⁴³

- RF energy advisory symbol (*e.g.*, Figure A.3 of C95.2-1999)

²⁴¹ These categories are analogous to the subsequently modified IEEE Std C95.7-2014. See Figure 1 of IEEE Std C95.7-2014 in comparison with Figure 1 of IEEE Std C95.7-2005.

²⁴² See OET Bulletin 65, *supra* n. 60.

²⁴³ Section 2.4 of the National Association of Broadcasters Engineering Handbook, 10th Edition; see also CDE Comments at 2.

- A description of the RF source (*e.g.*, transmitting antennas)
- Behavior necessary to avoid over-exposure (*e.g.*, do not climb tower unless you know that antennas are not energized; stay behind barrier or off of markings)
- Up-to-date contact information (*e.g.*, monitored phone number or email address connected to someone with authority and capability to provide prompt response).

92. Category One signage applies to locations where RF sources do not cause continuous or source-based time-averaged exposure in excess of the general population limit in Section 1.1310. Category One signs are optional and will show a green “INFORMATION” heading. These Category One signs may be used to offer information to the public that a transmitting RF source is nearby but that it is compliant with the Commission’s exposure limits regardless of duration or usage. Specifically, the sign could provide an explanation of safety precautions to be observed when closer to the antenna than the information sign (where applicable), a reminder to obey all postings and boundaries (if higher categories are nearby), and up-to-date licensee (or operator) contact information (if higher categories are nearby), or a place to get additional information (such as a website, if no higher categories are nearby).

93. AICC argues that the Category One sign is “dangerous and non-productive” because the public may interpret it as indicating a problem when there is none.²⁴⁴ To the extent AICC is concerned that a Category One sign would indicate a problem where none exists, our rules already offer a simple solution: don’t post one. Deploying Category One signs is voluntary. Still, there are situations in which some installations might warrant the use of Category One signs, for example, if the location where sign placement is feasible is not adjacent to the boundary where the general population exposure limit is exceeded,²⁴⁵ the “NOTICE” sign would provide awareness while avoiding oversignage.

94. Category Two signs and positive access controls are required where the continuous exposure limit would be exceeded for the general population, but not for occupational personnel. Category Two signs must have the signal word “NOTICE” in blue color. We allow under certain controlled conditions, such as on a rooftop with limited access (*e.g.*, a locked door with appropriate signage or antenna concealment), that a sign be attached directly to the antenna.²⁴⁶ A sign attached directly to an antenna will be considered sufficient only if it specifies a minimum approach distance and is readable from the direction of approach and at least at the separation distance required for compliance with the general population exposure limit in Section 1.1310. Appropriate training is required for any occupational personnel with access to the controlled area where the general population exposure limit is exceeded, and transient individuals must be supervised by occupational personnel with appropriate training upon entering any of these areas. Use of time averaging is required for transient individuals in the area where the general population exposure limit is exceeded. Though not required, use of personal RF monitors in the areas where the general population exposure limit is exceeded is an option to ensure compliance.

95. Category Three applies to locations where the exposure limit for occupational personnel would be exceeded potentially by no more than a factor of ten. Category Three requires signs with the appropriate signal word “CAUTION” in yellow color, and controls or indicators (*e.g.*, chains, railings, contrasting paint, diagrams), in addition to the positive access control established for Category Two, surrounding the area in which the exposure limit is exceeded. Under conditions where positive access controls are in place to effectively restrict access only to authorized persons in areas where the public

²⁴⁴ See AICC Reply at iii, 19 (claiming that the “Category One signage constitutes negative declaration of something that the consumer has not linked to the security system in their home or business to begin with.”); see also SiteSafe Comments at 4 (finds Category One sign confusing).

²⁴⁵ An example would be a rooftop hatch.

²⁴⁶ See IEEE Std C95.7-2005, Section 4.5.1.

limits are exceeded, we allow a sign to be attached directly to the antenna, and further we allow controls or indicators in place of signs, presuming that those authorized persons are trained to recognize and understand the actions necessary to control their exposure where the controls or indicators are placed at the occupational limit boundary. A sign affixed to an antenna will be considered sufficient only if it specifies a minimum approach distance and is readable from the direction of approach and at least at the separation distance required for compliance with the occupational exposure limit in Section 1.1310. Additionally, appropriate training is required for any occupational personnel with access to the controlled area where the general population exposure limit is exceeded, and transient individuals must be supervised by trained occupational personnel upon entering any of these areas. Use of time averaging is required for transient individuals to ensure compliance with the general population exposure limit. Though not required, use of personal RF monitors in the areas where the general population exposure limit is exceeded is an option to ensure compliance. Similarly, use of personal protective gear (such as properly-worn RF protective suits) is another option to ensure compliance for occupational individuals in the areas in which the occupational exposure limit is exceeded but is not a requirement for all situations. If such mitigation procedures or power reduction, and therefore Category reduction, are not feasible, then lockout/tagout procedures in 29 CFR § 1910.147 must be followed.

96. Category Four applies to locations where the exposure limit for occupational personnel would be exceeded by more than a factor of ten or where there is a possibility for serious contact injury. Where the occupational limit could be exceeded by more than a factor of ten, “WARNING” signs in orange color are required, and “DANGER” signs in red color are required where immediate and serious injury will occur on contact, in addition to positive access control.²⁴⁷ For example, “DANGER” signs are required at the base of AM broadcast towers where serious injuries due to contact burns may occur. If power reduction would not sufficiently protect against the relevant exposure limit in the event of human presence considering the optional additional use of personal protective equipment, lockout/tagout procedures must be followed to ensure human safety.²⁴⁸ Category Four signs indicate the most hazardous locations, and alert people to protect against potentially serious and immediate harm, even though Category Three signs already indicate an area surpassing the occupational exposure limit for continuous exposure. The only apparently adequate mitigation measure within the Category Four area is power reduction²⁴⁹ that will bring exposure within the occupational limits.²⁵⁰ The fact that the location of potential overexposure is temporary—like a scaffolding—does not relieve any of the licensees or operators of the obligation to warn or accommodate the workers that may be in the area of overexposure.²⁵¹

²⁴⁷ IEEE Std C95.7-2005 provides examples of the proper use of “DANGER” signs “as in the case of RF burns and/or RF electrical shocks.”

²⁴⁸ According to the National Association of Broadcasters Engineering Handbook, 10th Edition, OSHA’s “lockout/tagout” requirement (OSHA Regulations, 29 CFR § 1910.147) would require the appropriate transmitter to be shut down during the presence of occupational personnel. To prevent unexpected activation of the transmitter, “the circuit breaker feeding the transmitter should be locked (using a padlock) into the off position, and a warning tag placed to indicate that the transmitter may not be operated until the lock and tag are removed by the person who installed them.”

²⁴⁹ As recognized by Tell, turning off power completely (“lockout/tagout”) is an alternative. *See* Tell Comments at 14.

²⁵⁰ As for Tell’s request for content requirements of an environmental assessment, we note that those are already outlined in 47 CFR § 1.1311. *See Human Exposure to Radiofrequency Electromagnetic Fields*, DA 15-683, Small Entity Compliance Guide, released June 10, 2015. We further note that no applicant has ever exercised the option to submit an Environmental Assessment rather than take the steps needed to mitigate exposure so as to stay within the limits.

²⁵¹ We recognize the difficulty of this situation, and guidelines for reasonable efforts compliance will be provided in the Bulletin 65 to be published by OET.

97. H&E urges the Commission to remove the Category Four (10X occupational) requirement, because it does not correspond to an exposure limit.²⁵² We disagree. While ten times the limit is not explicitly listed in section 1.1310 of our rules, it forms the underlying basis of human protection and is inherently associated with our exposure limits because of the multiplicative margins incorporated into these limits when they were derived. This factor of ten times the occupational limit is thermally based on a whole-body SAR threshold of 4 W/kg and is intended to protect against behavioral disruption. Independent of these thermal protections, Category Four additionally seeks to protect against the possibility for serious injury (such as shocks or burns) from direct contact with objects having high potential, which on its own necessitates action to protect workers accessing such areas. Moreover, Category Four necessarily requires actions above and beyond what would be required under Category Three, by prohibiting access to such areas without reduction in power to a lesser Category (e.g., Category One, Two, or Three). Keeping this additional action level in place serves as a reminder to trained occupational personnel about the severity of consequences in entering such an area without undertaking additional proactive preventative measures.

98. OSHA has expressed general concern about workers who might be unaware of their potential for overexposure on a building;²⁵³ for example, the exposure level at one side of a door leading to a rooftop might be significantly below the public limit, but the limit might be exceeded soon after entering the rooftop area.²⁵⁴ If awareness and control of exposure by trained rooftop and other workers can be achieved with appropriate postings and markings of regions where the general population/uncontrolled limits are exceeded, then these workers may be exposed up to the occupational/controlled limits without site-specific training or supervision. Untrained workers should not have access to controlled locations without supervision. This concept would apply equally to any conventional or rooftop transmitter site as it would to a concealed or camouflaged antenna site, such as those found installed in church steeples, behind false walls or building facades, within faux vegetation, inside of storefront signs, lampposts, kiosks, *etc.*²⁵⁵ For the trained worker, in addition to standard signs, boundaries may be shown on diagrams at the access point and by rooftop paint markings in the Category Two and Three regions, and signs and/or barriers at the boundary of the Category Three region should ensure awareness and prevent exposure above the occupational/controlled limits. Where there are only Category Two regions, in addition to standard signs, a diagram at the access point and paint markings in the Category Two area would be sufficient, where positive access controls are in place to effectively restrict access only to authorized persons in areas where the public limits are exceeded. Where the

²⁵² See H&E Reply at 3-4.

²⁵³ OSHA Comments at 3 (discussing concerns over the extent to which workers receive RF awareness training and the readability of signs outside of the compliance boundary, and encouraging the Commission to develop guidance on appropriate procedures for workers accessing multi-use buildings and rooftops).

²⁵⁴ See SiteSafe Comments at 4.

²⁵⁵ We recognize that each transmitter site is unique, and many antennas are designed and installed to meet aesthetic goals and/or local zoning and building requirements. The intent of our signage requirements is to establish awareness for persons accessing areas near those antennas where our RF exposure limits are exceeded. The proper placement of such signs need not be obtrusive or counter to design goals. Where antennas are placed inside of structures or behind facades, a sign need be placed outside of that structure only if there is an area outside of that structure or facade where the limits are exceeded in a location that the general population could reasonably be anticipated to access. That sign need be of a size and placement only sufficient for legibility at the boundary of such area. Seldom will such a sign pose an aesthetic concern from the further distances and vantages of the general public. Where a concern remains, the antenna can be set further back from the outside of the façade to shrink or eliminate the exposure area and the corresponding size of the sign and its orientation. Where an antenna is atop a steeple, for example, it is unlikely there will be an area of human potential presence nearby, except at a high elevation from the ground and signage at such a location (e.g., the side of a building facing a steeple-mounted antenna) similarly should not pose an aesthetic concern.

general public (including untrained workers) may have access to such areas, however, they cannot be expected to understand the meanings of markings and signage, and barriers at all boundaries marked at regular intervals are required to ensure compliance.

99. Several commenters claim that the signage requirements are burdensome.²⁵⁶ Verizon and AT&T urge the Commission to require only a sign associated with the highest category at the site.²⁵⁷ We agree that placement of multiple signs contribute to the problem of oversignage, and hence, we provide that if the boundaries between Category Two and Three are such that placement of both Category Two and Three signs would be in the same location, then the Category Two sign is optional.²⁵⁸ Similarly, only a Category Four sign is necessary where Category Three and Category Four apply to the same location. Further, parties are not required to place multiple signs in places where exposure boundaries are close together.

100. Other commenters question our proposed rules regarding sign content and readability.²⁵⁹ The International Brotherhood of Electrical Workers (IBEW) claims that existing signs are often ambiguous and placed as a general warning, fail to protect IBEW members, and should not be considered a catchall for RF compliance.²⁶⁰ However, the four categories of signage specify consistent and widely recognized symbols, colors, and vocabulary to reliably convey the meaning of the signs. Our new rules seek to cover all possible exposure situations and to do so in a manner clearly appropriate to each situation, especially as technologies are quickly evolving, and these requirements may become relevant in the future. Further, a trained worker will be able to interpret the signs to appropriately control his/her exposure.

101. OSHA and Narda point out that the label or small sign permitted in controlled environments might not be readable from a safe distance, and suggest ways to ensure that signs can be read by the time that a worker encounters the exposure limit boundary.²⁶¹ Our new rules include the requirement that signs be legible *and* readily viewable and readable at a minimum distance of five feet (1.52 m) from the boundary (and as necessary on approach to this boundary) at which the applicable limits are exceeded, and that controls or indicators be placed *at* compliance boundaries. As to what would satisfy our requirement to be “readable,” we invoke OSHA rules regarding specifications for accident prevention signage.²⁶² Since OSHA’s rules require readability at a minimum distance of five feet

²⁵⁶ See Verizon Comments at 14-15; *see also* WIA Comments at 8-9 (opposing any requirement to place multiple category signs at a transmitter site or where each tier is exceeded); *see also* H&E Reply at 3-4 (arguing a signage requirement with up to four categories would be burdensome and could result in over-signage and confusion); WIA Reply at 4; UTC Reply at 8.

²⁵⁷ See Verizon Comments at 14-15 (arguing the rules should be specific about where signs must be located (access points and antennas) and what they should say); *see* AT&T Reply at 9 (arguing that Category Two NOTICE signs will be confusing, conflicting, impractical, and cause undue administrative burdens at sites where Category Three CAUTION signs are already required).

²⁵⁸ See *infra* Appx. A, Amended Rules 47 CFR § 1.1307(b)(4)(iii).

²⁵⁹ See Tell Comments at 13-14 (questioning the terminology and consistency of the proposed rules in dealing with access, control, and time-averaging and requests several clarifications); SiteSafe Comments at 4 (suggesting that signs must provide clear and specific instructions to transient individuals about how to mitigate exposure, which is not the case for current signs in common use, and requests that an update to OET Bulletin 65 include example language for signs as needed for transient individuals).

²⁶⁰ See IBEW Comments at 2. IBEW also points to non-rooftop issues and questions whether signs can be effective at antennas attached to poles, on the sides of buildings or water tanks, and stealth antennas.

²⁶¹ See OSHA Letter at 3; Narda Comments at 3.

²⁶² 29 CFR § 1910.145, Occupational Safety and Health Standards, Specifications for accident prevention signs and tags: “The signal word shall be readable at a minimum distance of five feet (1.52 m) or such greater distance as
(continued....)

(1.52 m) “or such greater distance as warranted by the hazard,” we expect that requiring signs to be legible, readily viewable, and readable as necessary on approach will satisfy OSHA’s concern. As also suggested by OSHA and SiteSafe in their comments, we will be developing additional guidance in a future revision of our supplementary material, including OET Bulletin 65, for compliance at multi-use sites.

102. To avoid oversignage and confusing signage, accurate placement of appropriate signage is critical and should make clear both where limits are exceeded and where limits are not exceeded. A number of commenters had specific suggestions on the placement of the signs. The EMF Safety Network suggests mandating setbacks of 1,500 feet from cell towers for signs.²⁶³ SiteSafe suggests signs be placed at the boundary of OSHA-required fall protection areas where exposure levels exceed our limits, indicating antenna locations and areas where exposure limits are exceeded because these areas may be accessed by workers using lifting or climbing devices.²⁶⁴ We find the suggested setback as unnecessary, impractical and inconsistent with our policies that distance to compliance boundaries be based on the effective radiated power and other variables related to the installation of transmitters at a site rather than a set distance. At the same time, we agree with SiteSafe that effective placement of signs is necessary to inform workers prior to accessing these areas. Parties interested in recommendations for sign layout, color, symbology, *etc.*, may refer to the detailed description in IEEE Std C95.2-1999, as well as the subsequent guidance materials we will offer on categories and signs in a future revised version of OET Bulletin 65. Further, while we also agree that a site safety plan may be an effective part of an acceptable routine evaluation, we do not adopt such a measure as a required component.²⁶⁵ Because each site is different, our rules are flexible about how to prevent access to spatial regions where the RF exposure limits are exceeded and what mitigation measures are adequate for each specific circumstance. Additional guidance on best practices for site safety plans may be released in future revisions of our supplementary materials, including OET Bulletin 65.

103. As suggested by CSCP, we will require signs to provide an up-to-date point of contact, but we decline RF Check’s suggestion of explicitly requiring 24/7 monitoring.²⁶⁶ We have no evidence that continuous round-the-clock monitoring is necessary or practical, , we anticipate that licensees with many installations in diverse locations would provide a contact that can respond expeditiously much as they do for maintenance issues that may arise in their networks. In many cases where the exposure is sufficiently limited such that remains below Category Three, there should be no need to contact a licensee because power reduction would be unnecessary for compliance with the occupational limits, as long as

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warranted by the hazard”; Howett, G.L., *Size of Letters Required for Visibility as a Function of Viewing Distance and Observer Acuity*, National Bureau of Standards, Washington DC, July 1983.

²⁶³ See EMF Safety Network Comments at 10. EMF Safety Network suggests that transmitters be turned off when workers are present. The Commission supports lockout/tagout procedures to turn off transmitters where necessary to maintain a safe working environment. See *infra* Appx. A, Amended Rules 47 CFR § 1.1307(b)(4)(iv)-(v).

²⁶⁴ SiteSafe Comments at 2-4 (Fall protection areas are required of employers so as to prevent employees from falling off of overhead platforms, elevated work stations or into holes in the floor and walls. See <https://www.osha.gov/SLTC/fallprotection/>.) In addition to signage, SiteSafe recommends that a safety plan be part of a routine evaluation and should be shared with licensees, site management, and personnel working at a site. For small indoor antennas, SiteSafe suggests that placement of signs at the antennas for Wi-Fi or other internet access points would not be practical and notes that some jurisdictions require stealth screening of outdoor antennas, which complicates sign placement for those antennas.

²⁶⁵ SiteSafe Comments at 4.

²⁶⁶ See CSCP Comments at 3 (supporting requirement for contact information on signs and emphasizes that the contact information be up-to-date, so that the public can readily obtain exposure information about sites where they have concerns); see also RF Check *Ex Parte* at 11 (“Safety Center Specialists are accessible 24/7 via Internet or phone.”).

workers are effectively made aware of their exposure and are able to exercise control over their exposure. We will monitor complaints about unavailability of contact points as they may arise and work with parties as appropriate. We will not specify a response time, as was suggested by Wessel, because normal good business practice should dictate prompt response, and the requirement for identification of the monitored contact point should be effective.²⁶⁷ We encourage parties responsible for such contact points to promptly respond to complaints and find appropriate solutions.

3. Training to Ensure Compliance

104. RF safety awareness training is critically important to ensure that exposed persons are fully aware of the potential for exposure and can exercise control over their exposure, as required in environments qualifying to apply occupational/controlled limits.²⁶⁸ Adequate training should provide trainees with a complete understanding of the actions necessary to ensure their compliance with the exposure limits in various circumstances. In the *2013 RF Further Notice*,²⁶⁹ in determining what would constitute “appropriate training,” we proposed to consider the topics outlined in Annex A of IEEE Std C95.7-2005 as guidance to be referenced in a future revision of OET Bulletin 65, and to allow for web-based training or similar programs.²⁷⁰

105. The record includes numerous requests for clarification regarding what constitutes adequate training under our rules. UTC requests that the Commission clarify mitigation requirements regarding “training and notification” and provide flexibility.²⁷¹ WIA suggests centralized training, either administered by the Commission in coordination with the Occupational Safety and Health Administration (OSHA) or through an association or trade group.²⁷² Tell requests a detailed definition of training, suggesting that limited but specific instruction on behavior near active antennas is all that is necessary in most cases.²⁷³ Similarly, Wessel suggests that training for occupational/controlled exposure needs a clear and detailed definition and that while it is possible for information conveyed by signs to be sufficient the signs might not remain in place.²⁷⁴ H&E suggests that training be consistent with Annex A of IEEE C95.7-2005, and subsequently IEEE C95.7-2014, but that some of the material be simplified for building maintenance personnel.²⁷⁵ H&E also recommends substantive testing and renewal requirements for training.²⁷⁶

106. The level of detail provided in the training section of IEEE C95.7-2014 demonstrates the difficulty in prescribing clear and simple criteria for what constitutes appropriate training. Accordingly, we direct OET to consider the topics outlined in Annex A of IEEE C95.7-2005 as training guidance to be referenced in a future revision of OET Bulletin 65 as promptly as practicable and with an eye towards providing appropriate language for those who will rely on it, and to continue to revise this guideline as

²⁶⁷ See Wessel Comments at 3 (stressing the importance of a timely response when using contact information on signs as maintenance on rooftops is often a matter of some urgency).

²⁶⁸ See *2013 RF Order and Notice*, 28 FCC Rcd at 3523, para. 75; see also, IEEE C95.7-2005; IEEE C95.7-2014.

²⁶⁹ *2013 RF Order and Notice*, 28 FCC Rcd at 3565, para. 195.

²⁷⁰ See *id.*

²⁷¹ See UTC Reply at 1, 7-8.

²⁷² See WIA Comments at 9.

²⁷³ See Tell Comments at 2.

²⁷⁴ See Wessel Comments at 3.

²⁷⁵ See also Motorola Comments at 8-9 (supporting the use of IEEE-C95.7-2005); see also IEEE-ICES Comments at 2.

²⁷⁶ See H&E Reply at 4.

experience dictates. For this, OET will coordinate with OSHA, as recommended by WIA, to ensure that the revision of Bulletin 65 will provide sufficient guidance to people who work in the presence of RF transmitters. In the case of training using oral information, we clarify that either spoken word or pre-recorded audio from an authorized individual qualified to provide such instructions on how to remain compliant is acceptable.²⁷⁷ Training may also include web-based programs.²⁷⁸ We also make clear that instant “training” via signage at an access door is insufficient to achieve the goal of compliance for those persons potentially exposed beyond that door, even assuming that diagrams of a rooftop are read and understood.

4. Responsibility for Mitigation Measures

107. Numerous comments requested limitations on a licensee’s responsibility for mitigation measures.²⁷⁹ Verizon, WIA, and others argued for a “safe harbor” from actions and events beyond their control at the restricted area when the area is not controlled by the licensee.²⁸⁰ Verizon contends that there is no practical action it can take to ensure continuously that certain sites are compliant.²⁸¹ According to Verizon, if a rooftop door is left unlocked by a third party despite Verizon’s best efforts to control exposure (including posting appropriate signs and implementing access controls), it should not be considered to have violated the Commission’s rules.²⁸² Verizon suggests that safe harbor requirements include the following elements: category-appropriate signage, access controls, indicative or physical barricades, RF safety training, information about RF exposure risks in accessible areas, and 24/7 contact information.²⁸³ Similarly, WIA urges that mitigation measures should include only those steps that the licensees can reasonably control and that the licensee should not be held liable when, despite its best efforts, a third party does not comply with mitigation requirements.²⁸⁴ WIA points out that rooftop access is typically managed by the building’s owner, whose duty should be to work with licensees to mitigate exposure.²⁸⁵ WIA also suggests that RF mitigation rules should not conflict with federal, state, or local laws or safety codes.²⁸⁶ Boston and Philadelphia opposed any safe harbor, on the grounds that a safe

²⁷⁷ See AT&T Comments to *Notice* at 1.

²⁷⁸ SiteSafe Comments at 5 (supporting our training requirement of written or oral instruction, or both, and suggesting that training could be accomplished by “class room, computer based, and on-the-job training from a competent instructor.”).

²⁷⁹ The Commission clarified the responsibilities of licensees at multi-use transmitter sites, and sought comment on the extent and limitation of these responsibilities, as well as how to encourage better cooperation between property owners, managers, and licensees, in response to commenters that suggested that our rules do not address the apportionment of responsibility among licensees in all situations. *2013 RF Order and Notice*, 28 FCC Rcd at 3525-26, 3564, paras. 80-84, 193.

²⁸⁰ See WIA Comments at 2-3, 5-8; Verizon Comments at 2, 10-13; AT&T Reply at 3-4, 8-9; AICC Reply at 20; WIA Reply at 1, 4-5; Verizon Reply at 4; Verizon Ex Parte at 2 (February 10, 2014); Verizon Ex Parte at 2 (May 6, 2015); Verizon Ex Parte at 1 (January 13, 2016); Verizon Ex Parte at 1 (June 15, 2018). *But see* Boston & Philadelphia Reply at 6; Gil Amelio Letter at 1; IBEW Comment at 1-2; AFGE/AFL-CIO Comment at 1; RF Check Ex Parte at 1 (March 4, 2014); RF Check Ex Parte at 1, 19 (October 8, 2014); RF Check Ex Parte at 20 (December 18, 2015); National Antenna and Tower Safety Center Ex Parte at 14.

²⁸¹ See Verizon Comments at 2, 10-13; Verizon Reply at 4; Verizon Ex Parte at 2 (February 10, 2014); Verizon Ex Parte at 2 (May 6, 2015); Verizon Ex Parte at 1 (January 13, 2016); Verizon Ex Parte at 1 (June 15, 2018).

²⁸² See Verizon Comments at 12; Verizon Ex Parte at 2 (February 10, 2014); Verizon Ex Parte at 1 (May 6, 2015); Verizon Ex Parte at 1 (January 13, 2016).

²⁸³ See Verizon Comments at 12.

²⁸⁴ See WIA Comments at 2-3, 5-8; WIA Reply at 1, 4-5.

²⁸⁵ See WIA Comments at 7.

²⁸⁶ See WIA Comments at 6.

harbor would excuse noncompliance and, instead, suggested that the Commission should look at the facts in any given case to determine responsibility.²⁸⁷ IBEW also opposes a safe harbor approach, noting in particular that signs by themselves should not be considered sufficient to establish compliance.²⁸⁸ UTC and AICC propose that new entrants should be responsible for mitigation at such sites.²⁸⁹

108. RF Check suggests that the Commission recognize that licensees alone cannot ensure compliance and that a comprehensive, uniform solution that involves all parties is necessary.²⁹⁰ RF Check proposes the creation of a database in which transmitting antennas are registered and their exposure areas calculated, with the antenna and exposure areas visually depicted.²⁹¹ This database would be accessed and viewed by a worker at any worksite via smartphone.²⁹² WIA supports a private sector neutral third-party collecting and distributing RF safety information as consistent with its recommendation that the Commission facilitate centralized training.²⁹³ We decline to mandate the registration of each transmitting antenna in a database. Such proposal is overbroad and burdensome. With the implementation of 5G technologies such requirement will impose costs to licensees and operators while its benefit is not necessarily evident. Carriers are densifying their networks with an increasing speed, and though at times they might place antennas in non-visible locations, most of them can be seen and recognized. Further, the RF characteristics of such antennas vary, impacting the degree of RF exposure.

109. Such a comprehensive catalogue of sites and “safety” zones would further impose a burden on all site owners, regardless of whether they are able to achieve effective compliance without such participation. Moreover, mandating such participation would effectively delegate our responsibility to an organization over which we have no oversight or control.²⁹⁴ Additionally, in the absence of full data on all RF sources, reliance on such a system could expose unwitting users who rely exclusively on that system to RF exposure in excess of our limits from sources not accounted for in that system. Accordingly, we do not adopt a safe harbor for site compliance. If any licensee chooses to outsource its compliance function to a third party, it can do so, but the licensee would remain wholly liable for compliance.

110. Regarding the effectiveness of mitigation measures at transmitter sites to ensure compliance,²⁹⁵ Narda argues that a locked rooftop with posted signs is not effective and that barriers are needed because third-party workers who are given access may not be able to identify an antenna so as to stay a certain distance away from it.²⁹⁶ EMRPI also states that wireless sites with concealed or camouflaged antennas are common, so workers with access to them have no knowledge of their exposure

²⁸⁷ See Boston & Philadelphia Reply at 6.

²⁸⁸ See IBEW Comment at 1-2.

²⁸⁹ See UTC Reply at 1; AICC Reply at iii.

²⁹⁰ See RF Check Comments at 3-4, 8.

²⁹¹ *Id.*

²⁹² *Id.*

²⁹³ See WIA Reply at 5.

²⁹⁴ See *U.S. Telecom Ass’n v. FCC*, 359 F.3d 554, 565-69 (D.C. Cir. 2004).

²⁹⁵ See *2013 RF Order and Further Notice*, 28 FCC Rcd at 3530, para. 100 & n.172.

²⁹⁶ See EMRPI Comments at 10; Narda Comments, ET Docket No.13-84, at 1; see also Wessel Comments at 2 (contends that few licensees with fixed rooftop transmitters have appropriate signs, associated training, or procedures to identify exposure categories, and that access is often granted to individuals without knowledge or ability to control exposure, so that restriction on access does not result in a “controlled environment” as defined in IEEE Std C95.7-2005/C95.7-2014).

and no recognition that a site could be hazardous.²⁹⁷ We agree, and the rules we adopt reflect that signs alone do not comprise an RF safety program; however, the composition of a barrier within a controlled area might be either a restrictive, physical barrier, or an indicative barrier depending on the unique circumstances of the site, so workers, who are required to be trained, may readily recognize the antennas in the controlled area.

111. IBEW states that ensuring compliance with the exposure limits by the licensee is not effective and cannot or is not being enforced. While IBEW believes that the licensee's responsibility is a non-delegable duty, it suggests that practical RF safety should be a shared responsibility maintained among regulators, licensees, property owners and managers, employers, employees, and subcontractors.²⁹⁸ It indicates it is assessing the potential overexposure of its members, and recommends that all parties work with RF Check to ensure compliance with the Commission's exposure limits.²⁹⁹ RF Check suggests that the Commission make explicit that a licensee's compliance with Commission rules does not relieve an employer of its duties under OSHA regulations.³⁰⁰

112. These claims of the alleged prevalence of noncompliance at rooftop sites, although unsupported by empirical evidence, seem to be animating, in part, the calls for a safe harbor on the part of the wireless carriers who fear Commission enforcement action for sites they do not control. Dependence on property owners who may find those controls to be a nuisance or even in conflict with other safety goals (*e.g.*, locked egress doors) or legal requirements (*e.g.*, set-backs) is problematic. We find that a licensee's due diligence in ensuring compliance with the RF exposure requirements is the appropriate test for a safe harbor. As discussed by Verizon, we anticipate that due diligence would include elements such as category-appropriate signage, access controls, indicative or physical barricades, RF safety training, information about RF exposure risks in accessible areas, and 24/7 contact information. We recognize that the specific elements that are appropriate for any given installation may differ, such as situations where local safety codes require access to the roof at all times in case of emergencies. Therefore, we would consider the totality of the measures that were taken in any given instance. The greater specificity we provide regarding effective mitigation measures should go a long way to reducing the concerns of licensees³⁰¹. We appreciate that operators should not be held responsible for things beyond their control. With regard to the various parties raising concerns about a safe harbor, we note that we have taken

²⁹⁷ See EMRPI Reply at 4.

²⁹⁸ See IBEW Comments at 3.

²⁹⁹ See *id.*

³⁰⁰ See RF Check Comments at 7.

³⁰¹ See, *e.g.*, Verizon Ex Parte at 1 (May 6, 2015), in requesting that the Commission adopt a safe harbor "with respect to carrier efforts to restrict access to radio frequency transmitters located at rooftop locations, ... Verizon is committed to operating and does in fact operate safe and effective transmitters, but the actions of third parties that carriers cannot control may limit in some cases what carriers can do to prevent unauthorized access to transmitter sites."; Boston & Philadelphia Reply at 6: "[Commission adoption of 'safe harbors'] would seem to invite any number of easy excuses for RF radiation risks to untrained or unaware persons. The better solution, we believe, is give providers every incentive to inform third parties of these risks and enlist their help in protection. In the end, not all over-exposure can be prevented, but the facts of any given case should determine whether the provider or the interloper or some third party is to blame"; Gil Amelio Letter at 1: "It appears that some carriers are continuing to ask the FCC to grant them a safe harbor for merely maintaining the antiquated system of signs and fences that fails to protect workers in today's wireless environment."; IBEW Comment at 1: "Granting the discussed 'safe harbors' and reducing the frequency of inspections would only aggravate the already hazardous situation facing our members, making it even more difficult for them to assess situations and take the safety precautions needed to protect themselves from unnecessary risk."; AFGE/AFL-CIO Comment at 1: "This is not the first time carriers have requested a safe harbor. It appears their concern has more to do with protecting their financial interests rather than RF safety. Displaying a lack of willingness to address RF radiation exposure will only result in workers continuing to be exposed needlessly."

numerous steps in this proceeding to clarify a licensee's obligations and these requirements are enforceable. Moreover, responsibility for maintenance of the conditions that permit a siting within our rules can be an enforceable condition of any such lease.³⁰²

113. In reference to UTC's and AICC's comments on the responsibilities and potential liabilities of new entrants at multiple transmitter sites, we recognize that an entity responsible for new construction or modification of existing facilities could bring a compliant site out of compliance. First, we reiterate that all licensees subject to Section 1.1307(b) of our rules continue to share responsibility for maintaining compliance and the obligation to bring a previously-compliant site back into compliance, as may be necessary. This requirement, along with the requirement for new and renewal applicants to evaluate and ensure compliance at sites, is an important mechanism to maintain ongoing compliance.³⁰³ It is critical that all occupants of a site share responsibility to ensure that compliance at a site is maintained. Second, if an environmental change or other external factor or event occurs that brings a site out of compliance, all licensees share the responsibility for any modification or remediation necessary to bring the site into compliance. Finally, if a site is found out of compliance, a licensee that can demonstrate that its facility was compliant and did not cause the non-compliance will not be liable in an enforcement proceeding relating to the period of non-compliance. This approach allows the consideration of evidence on a case-by-case basis during any appropriate enforcement action and addresses the commenters concern to avoid inappropriately assigning liability to innocent parties where the source of noncompliance can be identified.

114. We reject Portland's argument that, in addition to the Commission's requirements concerning warning signs and barriers, local authorities should be allowed to require additional signs and access restriction where they deem them appropriate.³⁰⁴ While Section 332(c)(7)(B)(iv) of the Act permits state and local governments, when making decisions on the "placement, construction, and modification" of personal wireless service facilities, to consider whether such facilities comply with the Commission's regulations concerning RF emissions, it expressly prohibits them from imposing their own regulations on such facilities on the basis of the environmental effects of such emissions.³⁰⁵ Thus, "[p]ursuant to Section 332(c)(7), and consistent with the Commission's general authority to regulate the operation of radio facilities, State and local governments are broadly preempted from regulating the

³⁰² Wessel contends that there is a lack of cooperation among property owners, managers, licensees, and subcontractors amounting to a "systemic failure" in the industry and suggests that since property owners and managers have been held accountable by the Commission's Enforcement Bureau for interference caused by equipment on their property the same could be done for violation of RF exposure limits on the property. *See* Wessel Comments at 2. (We observe that each of these occasions was related to violations in the use of unlicensed devices, which are enforceable under our rules on the users of the device.) Wessel also references an insurance industry article dealing with property manager and owner risks associated with RF exposure. *See* Wessel Comments at 3. (While this point may illustrate the potential seriousness of violation, it is not obviously relevant to placing compliance responsibility, and it is not discussed in our resolution.)

³⁰³ *See 2013 RF Order and Notice*, 28 FCC Rcd at 3526, para. 84:

We note that when routine evaluations are required at such sites, all relevant co-located licensees are responsible for compliance. Therefore, it is in the interest of these licensees to share information about power and other operating characteristics in order to achieve accurate representations of the RF environment. The Commission continues to encourage all site occupants, owners, leasers, and managers to cooperate in these endeavors, and we note that site user agreements are particularly useful and desirable to achieve this end. As demonstrated in the record, all licensees that exceed five percent of the RF exposure limit at any non-compliant location are jointly and severally responsible, and the Commission may impose forfeiture liability on all such licensees.

³⁰⁴ City of Portland Comments at 4.

³⁰⁵ 47 U.S.C. § 332(c)(7)(B)(iv).

operation of personal wireless service facilities based on RF emission considerations.”³⁰⁶ The Commission’s rules echo this statutory provision.³⁰⁷ Many courts have confirmed that state or local regulation of RF emission safeguards would “disrupt the expert balancing underlying the federal scheme” in the context of proceedings such as this one, where the Commission has “weighed the competing interests relevant to the particular requirement in question, reached an unambiguous conclusion about how those competing considerations should be resolved, and implemented that conclusion via a specific mandate.”³⁰⁸ Indeed, as noted above,³⁰⁹ state-level warning regimes risk contributing to an erroneous public perception or otherwise disrupt the federal regime.

D. Transition Periods

115. As an initial matter, we emphasize that compliance with the RF exposure limits is an existing requirement that applies to all licensees, as well as grantees of portable, mobile, and unlicensed device equipment authorizations, irrespective of whether they were exempt from evaluation under the old rules. Licensees are always responsible for the compliance of their sites and their equipment in protecting persons from RF exposure in excess of our limits. Still, our new rules will provide greater clarity and certainty to licensees, equipment manufacturers, and the public.

116. Even though we anticipate that comparatively few facilities will require evaluation under the new rules, and such evaluations will be relatively straightforward, in order to ameliorate any hardship caused by the change to the new exemption and evaluation framework, we set a timetable for conducting the reevaluation, under the new rules, of antenna locations that were previously exempt from evaluation under the existing rules. We will allow two years from the effective date of the new rules for licensees to determine if evaluations are required, to perform them where necessary, and to comply with the more specific mitigation requirements we adopt in this order as may be necessary.³¹⁰ This transition period comports with the essentially unanimous view of commenters in their consideration of the scope and logistics involved,³¹¹ and in our experience should be adequate for those with the largest number of sites to evaluate or to reevaluate.³¹² This two-year transition period will allow not only licensees and manufacturers to complete the evaluations or determine whether they are exempt from evaluation, but will also allow an orderly transition for the licensing Bureaus and the FCC equipment authorization program to incorporate the new exemption criteria into their station authorization and certification policies and procedures.

³⁰⁶ *Procedures for Reviewing Requests for Relief from State and Local Regulations Pursuant to Section 332(c)(7)(B)(v) of the Communications Act of 1934*, 15 FCC Rcd 22821, 22828, para. 17 (2000) (citing *Cellular Phone Task Force v. FCC*, 205 F.3d 82, 95-96 (2d Cir. 2000)); see also *New York SMSA Ltd. P’ship v. Town of Clarkstown*, 612 F.3d 97, 105 (2d Cir. 2010) (the Act “occupies the field” of “regulation of the technical and operational aspects of wireless telecommunications service,” to the exclusion of state or local regulation).

³⁰⁷ 47 CFR § 1.1307(e).

³⁰⁸ *Farina v. Nokia, Inc.*, 625 F.3d 97, 123, 126 (3d Cir. 2010) (quoting *Medtronic, Inc. v. Lohr*, 518 U.S. 470, 501 (1996), and citing *Buckman Co. v. Plaintiffs’ Legal Committee*, 531 U.S. 341, 348 (2001)); accord *Robbins v. New Cingular Wireless PCS, LLC*, 854 F.3d 315, 319-20 (6th Cir. 2017) (“By delegating the task of setting RF-emissions levels to the FCC, Congress authorized the federal government—and not local governments—to strike the proper balance between protecting the public from RF-emissions exposure and promoting a robust telecommunications infrastructure.”).

³⁰⁹ See para. 16 *supra*.

³¹⁰ See AT&T Reply at 11.

³¹¹ H&E Reply at 4; Verizon Comments at 15; WIA Comments at 5; SiteSafe Comments at 5.

³¹² We note that this is six months longer than the period that was recently agreed to with one of the major cellular telephone service providers. See *Cellco Partnership*, Order, 29 FCC Rcd 4789, 4794 (EB 2014).

117. We reiterate and emphasize that all licensees and grantees are responsible for compliance of their facilities and equipment with our RF exposure rules irrespective of their exemption status. Even though licensees are provided with adequate time to reevaluate locations, they still bear the responsibility of protecting persons from RF exposure in excess of our limits. As such, while lack of utilization of the signage and other guidance provided in this *Order* will not constitute a *per se* violation of mitigation requirements during the transition period, all responsible parties are liable at all times for providing appropriate protection from RF exposure above our limits, and thus should be motivated to adopt the measures that best ensure our agreement with their compliance—those measures adopted herein—as soon as possible.

E. Conforming Edits

118. In the *2013 RF Further Notice* we proposed to reword some of our rules in sections S 1.1307(b), 1.1310, 2.1091, and 2.1093 as necessary to ensure clarity and consistency.³¹³ In addition, we proposed to make changes to specific sections of Parts 15, 24, 25, 95, and 97 for consistency and as necessary depending on the substantive changes in Parts 1 and 2.³¹⁴ Because the Commission proposed that our general exemption criteria apply to all rule parts authorizing RF sources, specific exceptions provision in rule parts other than in Parts 1 and 2 are not necessary. Nonetheless, where various existing rule parts include paragraphs or sections concerning RF exposure requirements, we are updating those for consistency. No specific comments were received on these proposals and we adopt each of them for the reasons set forth in the *Further Notice*. Accordingly,

- For applicants for equipment authorizations covered by Parts 15 and 18, in Sections 15.212(a)(viii), 15.247(i), 15.255(g), 15.257(g), 15.319(i), 15.407(f), 15.709(h), and 18.313, we substitute our general exemption criteria for the specific exemption from routine evaluation;
- For applicants and licensees in the Public Mobile Service Personal Communications Service, we add and substitute our general exemption criteria for the specific exemption from routine evaluation in Sections 22.379 and 24.52;
- For applicants and licensees of satellite earth stations, we remove the 5 percent criterion in Section 25.117(g) and introduce similar language to Section 25.115, paragraph (p), Section 25.129, paragraph (c), Section 25.149, paragraph (c)(3), and Section 25.271, paragraph (g);
- For applicants and licensees in the Miscellaneous Wireless Communications Services, Radio Broadcast Services, and Private Land Mobile Services we substitute our general exemption criteria for the specific exemption from routine evaluation by modifying Section 27.52, Section 73.404, paragraph (e)(10), and by adding Section 90.223 and removing Section 90.223;
- We add mobile devices to Section 95.2385 for WMTS and edit Section 95.2585 to eliminate the limited specification of FDTD modeling for MedRadio service medical implants;
- For applicants and licensees in the Amateur Radio Service, we substitute our general exemption criteria for the specific exemption from routine evaluation based on power alone in Section 97.13(c)(1) and specify the use of occupational/controlled limits for amateurs where appropriate; and

³¹³ *2013 RF Order and Notice*, 28 FCC Rcd at 3569, para. 204.

³¹⁴ *Id.*

- For applicants and licensees in the Multichannel Video Distribution and Data Service, we substitute our general exemption criteria for the specific exemption from routine evaluation of stations in the 12.2-12.7 GHz frequency band with output powers less than 1640 watts EIRP, in Section 101.1425.

Each of these changes will improve consistency and clarity of the rules.

V. NOTICE OF PROPOSED RULEMAKING

119. This *Notice of Proposed Rulemaking (NPRM)* seeks to develop a record that will enable us to address the challenges presented by evolving technological advances. Devices are operating in new frequency bands, changing the way we use wireless devices, the way the supporting wireless infrastructure is deployed, and the way RF sources in general are assessed for compliance. One example is technologies using millimeter-wave and sub-millimeter wave frequencies for mobile communications applications, where the Commission already has established power density limits across these frequencies, but we seek comment below on localized exposure limits for devices held close to the body. Another example is new wireless power transfer (WPT) technologies, including some that are designed to dynamically focus energy on a device at a distance. where, particularly for inductive WPT equipment, the Commission already has established power density limits across many of the frequencies being used for such technology, but we seek comment below on internal electric field limits, where appropriate. These and other similar applications of RF energy being developed raise questions as to how to determine compliance with the RF exposure limits.

120. In this *NPRM*, we seek comment on expanding the range of frequencies for which the RF exposure limits apply; (noting that exposure limits are already in effect from 100 kHz to 100 GHz) on incorporating into our rules localized exposure limits above 6 GHz in parallel to the localized exposure limits already established below 6 GHz; on specifying the conditions under which and the methods by which the limits are averaged, in both time and area, during evaluation for compliance with the rules; and on addressing new issues raised by WPT devices. Although we terminated the *Inquiry* noticed in ET Docket No. 13-84 above,³¹⁵ there are some proposals on which we seek comment in this *NPRM* that stem from matters discussed in that proceeding,³¹⁶ some of which overlap with the issues identified immediately above.³¹⁷

121. This *NPRM* proposes methods and seeks comment on how to best incorporate new RF technologies, new methods and techniques for RF transmission, and new usages for a variety of RF spectrum bands into our preexisting exposure framework. In particular, on the topic of body-worn spacing during testing of cell phones, we continue to strive to ensure that such spacing represents realistic values for present-day technology and common usage.³¹⁸ The new technology and use of frequencies acknowledged in the *2013 RF Order and Notice* but not directly addressed in our rules, and the consequent testing methods they entail,³¹⁹ are also addressed in this *NPRM*. As part of this effort, we also further explore the issue of approval for equipment using new methods and technologies. With respect to any special considerations for children and consumer information, we refer to the FDA website, which

³¹⁵ See *supra* Section III.

³¹⁶ See *RF Order and Notice*, 28 FCC Red at 3570-89, paras. 205-52.

³¹⁷ The comments from that proceeding will not be included in the instant docket, as the overwhelming majority of those comments are unrelated to the issues raised in this docket and those that are relevant here are typically intermingled in the same filings as unrelated comments. Parties should refile in this docket any information or comments that they deem to be still relevant to the specific proposals in this docket.

³¹⁸ See, e.g., KDB Publication 447498.

³¹⁹ *2013 RF Order and Notice*, 28 FCC Red at 3580, para. 229.

states that “[t]he scientific evidence does not show a danger to any users of cell phones from RF exposure, including children and teenagers.”³²⁰ In general, we will update the information on our website as may be necessary to satisfy our commitment to ensure compliance with established exposure limits without expressing opinions on potential long-term health impact or current research activities where this is a more appropriate role for the health agencies. Finally, we will provide information to the public that is useful in understanding our rules and the way they will be enforced.³²¹

A. Extension of Exposure Limits to Additional Frequencies

122. Our RF exposure rules provide that specific absorption rate (SAR) will be evaluated within the frequency range of 100 kHz to 6 GHz and, similarly, they provide for evaluation of maximum permissible exposure (MPE) field strength and power density within the frequency range of 300 kHz and 100 GHz.³²² The standards for localized specific absorption rate (SAR) that are normally applied for testing compliance of consumer devices operating below 6 GHz were derived from the Maximum Permissible Exposure (MPE) whole body limits. The Commission currently employs a similar derivation to apply localized limits where appropriate for testing consumer devices operating above 6 GHz. This approach, however, is not formalized in our rules. We most recently invited comments in the *2013 RF Order and Notice* as to whether the Commission should establish specific exposure limits and measurement protocols outside these frequency ranges.³²³ We noted that some inductive wireless chargers operate at frequencies below 100 kHz, and Commission staff has been approached by parties seeking guidance on how to determine compliance for wireless car chargers generally operating at similarly low frequencies.³²⁴ We are aware of three extant guidelines for RF exposure that extend to frequencies below 100 kHz: ICNIRP 2010,³²⁵ IEEE Std C95.1-2005,³²⁶ and more recently, Health Canada

³²⁰ U.S. Food and Drug Administration, Children and Cell Phones, <https://www.fda.gov/radiation-emitting-products/cell-phones/children-and-cell-phones>; see also Statement from Jeffrey Shuren, M.D., J.D., director of the FDA’s Center for Devices and Radiological Health on the recent National Toxicology Program draft report on radiofrequency energy exposure (Feb. 2, 2018), <https://www.fda.gov/news-events/press-announcements/statement-jeffrey-shuren-md-jd-director-fdas-center-devices-and-radiological-health-recent-national> (“I want to underscore that based on our ongoing evaluation of this issue and taking into account all available scientific evidence we have received, we have not found sufficient evidence that there are adverse health effects in humans caused by exposures at or under the current radiofrequency energy exposure limits. Even with frequent daily use by the vast majority of adults, we have not seen an increase in events like brain tumors. Based on this current information, we believe the current safety limits for cell phones are acceptable for protecting the public health.”).

³²¹ We acknowledged in the *Inquiry* the guidance given by WHO that extra precautionary efforts, such as providing information describing effective means for the public to reduce exposure below recognized scientifically-based limits, is considered by the WHO to be unnecessary but acceptable so long as such efforts do not undermine exposure limits based on known adverse effects. See World Health Organization (WHO), *Model Legislation for Electromagnetic Fields Protection*, Articles 2.1, 7.4 and 7.5, 2006, ISBN 978 92 4 159432 5, http://www.who.int/peh-emf/standards/EMF_model_legislation_2007.pdf?ua=1.

³²² See 47 CFR § 1.1310 Radiofrequency radiation exposure limits. The Commission’s fundamental responsibility with respect to health risk to humans for all RF devices is expressed in section 1.1307 of our rules (47 CFR § 1.1307) and our OET has provided case-by-case guidance on WPT issues.

³²³ *2013 RF Order and Notice*, 28 FCC Rcd at 3580, para. 229.

³²⁴ See *2013 RF Order and Notice*, 28 FCC Rcd at 3580, para. 229.

³²⁵ International Commission on Non-Ionizing Radiation Protection (ICNIRP) *Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz)*, Health Physics 99(6): 818-836, 2010. ICNIRP Publication – 2010, available at <http://www.icnirp.org>.

³²⁶ Institute of Electrical and Electronics Engineers, Inc. (IEEE) *Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005, copyright 2006 by IEEE, New York, New York 10016-5997. See also the recently published (October 4, 2019) Institute of Electrical and Electronics Engineers, Inc. (IEEE) *Standard for Safety Levels with Respect to Human Exposure to Electric*,
(continued....)

Safety Code 6 (2015).³²⁷ All of these guidelines are aimed at prevention of electrostimulation due to RF electric fields induced internally within the human body in the presence of an external electromagnetic field outside the body—the primary human reaction to electromagnetic field energy at these frequencies. The internal electric field (E_i) would be analogous to SAR as an internal dosimetric measure, in contrast to the MPE limits on external fields, but where SAR is intended to prevent excessive body heating, the internal electric field avoids neural stimulation effects unrelated to heating.³²⁸ The three standards have similar values for limiting the internal electric field (E_i), although they have rather different approaches to the dosimetry used to derive their respective MPE limits on external fields from those E_i values. We seek comment on the significance of the differences among the preceding three guidelines.

123. While each of the standards appear to provide appropriate E_i guidelines, the ICNIRP 2010 guidelines are the most recent that are widely accepted internationally.³²⁹ Accordingly, we propose to adopt limits on E_i similar to these ICNIRP 2010 guidelines in our rules for frequencies between 3 kHz to 10 MHz. We do not propose to apply these guidelines below 3 kHz because our table of frequency allocations begins at 8.3 kHz and there are no established provisions for devices to operate at lower frequencies.³³⁰ We seek comments on these proposals and on other relevant and authoritative standards that commenters deem appropriate for consideration.

124. We propose to overlay ICNIRP 2010 electrostimulation limits for E_i on our existing SAR limits for frequencies between 100 kHz and 10 MHz. Because of the fast response of neural stimulation relative to heating, it is appropriate to apply electrostimulation limits without time averaging (in addition to time-averaged SAR limits) to fields at frequencies well above 100 kHz.³³¹ However, we do not propose to amend or extend our MPE limits on external fields.³³² This would place E_i alongside SAR as a

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Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz, IEEE Std C95.1-2019, copyright 2019 by IEEE, New York, New York 10016-5997.

³²⁷ Health Canada Safety Code 6 - *Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz* (2015), available at http://www.hc-sc.gc.ca/ewh-semt/consult/2014/safety_code_6-code_securite_6/final_finale-eng.php (last accessed March 14, 2018).

³²⁸ Adverse neural stimulation effects mentioned by these standards include acute effects such as perception of tingling, shock, pain, or altered behavior due to excitation of tissue in the body's peripheral nervous system. Applications in these frequencies include wireless power transfer technologies associated with charging electrical vehicles. We note that the Society of Automotive Engineers (SAE) standard J2954 for automotive WPT has called for compliance with ICNIRP 2010. See https://www.sae.org/standards/content/j2954_201605/.

³²⁹ For example, at least Germany, Japan, China, and Canada so far have adopted limits consistent with ICNIRP 2010, either by adopting limits derived based on similar considerations or directly by reference. (For example, Canada has adopted its recently updated Safety Code 6 which specifies the same internal electric field limits as ICNIRP 2010, while Germany and Japan have explicitly cited ICNIRP 2010 in their regulations.) See, e.g., <https://www.qualcomm.com/media/documents/files/requirements-for-human-exposure-assessment-of-wireless-electric-vehicle-charging-wevc-systems.pdf>.

³³⁰ 47 CFR § 2.106.

³³¹ Neural stimulation time constants are measured in hundreds of microseconds (see *Applied Bioelectricity*, Reilly, J. P., p. 246, Tbl. 1 (1998)), as compared to thermal time constants for RF heating of skin of typically measured in tens or hundreds of seconds (see *Thermal Response of Human Skin to Microwave Energy: A Critical Review*, Foster, K. R., et. al., Health Physics, Vol. 111, Issue 6, p. 530, Figure 2 (2016)).

³³² We note that, except under rare circumstances, the MPE and SAR limits will be the predominantly more restrictive limits above a about few hundred kHz. In other words, MPE and SAR exposure limits will reliably protect against any adverse tissue heating resulting from most (if not all) communications sources of RF energy regulated by the Commission, while the proposed internal electric field limit will protect against any adverse electrostimulation responses in nervous tissue not directly related to heating, such as extremely fast, short-duration pulses of RF energy not common for communications devices over the frequency range in which these limits would

(continued....)

co-primary limit³³³ between 100 kHz and 10 MHz and continues our policy that MPE limits are secondary.³³⁴ Guidance on how to comply with both limits within this frequency range may be developed as necessary for particular applications.³³⁵ We seek comment on these proposed numerical limits, and on the guidance demonstrating compliance with such limits

125. As technologies push the boundaries into spectrum ranges not previously used or anticipated, we now contemplate new rules on how to determine RF exposure compliance at these frequencies and eliminate uncertainty that may delay investment and development of new technologies. The Commission has no specific RF exposure limits above 100 GHz for new licensed services and unlicensed devices.³³⁶ Although the radio spectrum is managed up to 3,000 GHz (3 THz), our exposure limits are currently specified only up to 100 GHz.³³⁷ And since the exposure limits are constant from 6 GHz all the way up to 100 GHz³³⁸ (due to minimal body penetration), these limits could in principle be applied up to far infrared wavelengths.³³⁹

126. We are unaware of any reason the limits should be different above 100 GHz than across the already existing wide frequency range. As the difference in body penetration further diminishes towards zero, there is no apparent reason to expect that thermal effects will effectively change in the increasingly higher frequencies. Accordingly, we propose to extend the same constant exposure limits that presently apply from 6 GHz to 100 GHz up to an upper frequency of 3,000 GHz (3 THz), which is considered to be the upper bound of existing radiofrequency bands.³⁴⁰ Starting at 300 GHz or a wavelength of 1,000 micrometers (μm), standards have been developed for lasers primarily for application in industrial settings.³⁴¹ In an effort by standards bodies to match the laser standards, RF

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apply. Thus, although we expect that most RF sources will be unaffected by this proposed change, preventing electrostimulation effects, even under rare circumstances, is necessary to protect the public consistent with our obligations under NEPA.

³³³ This means that both Ei and SAR limits must be met between 100 kHz and 10 MHz.

³³⁴ See 47 CFR § 1.1310(a) (“Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b) within the frequency range of 100 kHz to 6 GHz (inclusive).”); see also *2013 RF Order and Notice*, 28 FCC Rcd at 3506-09, paras. 20-27 (“Primacy of Specific Absorption Rate (SAR) over Power Density or Field Strength below 6 GHz”).

³³⁵ We propose that our policy on recommended best practices for evaluation techniques to comply with both Ei and SAR in the frequency range between 100 kHz and 10 MHz should be contained in our Bulletins and in other supplemental materials, such as the OET Laboratory Knowledge Database (KDB).

³³⁶ See *Spectrum Horizons*, First Report and Order, FCC 19-19, para. 43 (Mar. 15, 2019) (*Spectrum Horizons R&O*); see also *Spectrum Horizons*, Notice of Proposed Rule Making, 33 FCC Rcd 2438, 2473, para. 82 (2018) (*Spectrum Horizons NPRM*).

³³⁷ *Id.*

³³⁸ See 47 CFR § 1.1310. The power density limits specified for general population and occupational exposure for 1.5 GHz up to 100 GHz are 1 mW/cm² and 5 mW/cm² respectively for whole-body continuous exposure.

³³⁹ *Spectrum Horizons R&O*, at para. 43.

³⁴⁰ We note over the frequency range between 1.5 GHz and 6 GHz that the power density limits specified for general population and occupational exposure are 1 mW/cm² and 5 mW/cm² respectively for whole-body continuous exposure.

³⁴¹ See, e.g., International Commission on Non-Ionizing Radiation Protection (ICNIRP) *Guidelines on Limits of Exposure to Laser Radiation of Wavelengths between 180 nm and 1,000 μm* , Health Physics 105(3):271-295; 2013. ICNIRP Publication – 2013, available at <http://www.icnirp.org>.

limits have been increased at millimeter wave frequencies;³⁴² however, we do not feel it is appropriate to relax our limits at higher frequencies for exposure from consumer communication devices, considering the already minimal skin depth at 100 GHz. Accordingly, we propose to extend our existing limits to 3,000 GHz (3 THz) to stay ahead of the possibility of technologies being introduced that are only nascent or unknown today. We note that most of the services being contemplated in the *Spectrum Horizons* proceeding are within 95-275 GHz frequencies,³⁴³ but there may be other potential applications or services being contemplated above these frequency bands. We seek comment on this proposal. Specifically, we seek comment on the frequency range over which these proposed limits would apply.

1. Localized Exposure Limit for Higher Frequencies

127. Newer technologies that employ techniques such as adaptive array antennas created by fluctuating multi-beam sources create complex electromagnetic fields that present challenges for present-day RF measurement methods.³⁴⁴ The Commission's RF exposure rules do not yet specify a spatial maximum power density limit for localized exposure at higher frequencies.³⁴⁵ As portable devices are being developed for operation at higher frequencies for future 5G services in millimeter-wave bands, we propose a general localized power density exposure limit above 6 GHz of 4 mW/cm² averaged over 1 cm² for the general population or uncontrolled exposure, applicable up to the upper frequency boundary of 3 THz, also proposed above.³⁴⁶ We invite comments on this proposal. Both the ICNIRP guidelines and the IEEE standards specify a spatial maximum power density, at least at higher frequencies (*e.g.*, between 3GHz and 10 GHz) of 20 times the whole-body MPE limit, generally averaged over 1 cm².³⁴⁷ We also propose a localized exposure limit above 6 GHz for occupational or controlled exposure of 20 mW/cm² averaged over 1 cm², which is consistent with the typical increased ratio of 5:1 for the occupational limits

³⁴² See, *e.g.*, International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, 74 Health Physics 494 (1998); Institute of Electrical and Electronics Engineers, Inc. (IEEE), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005 (2006).

³⁴³ *Spectrum Horizons R&O*, FCC 19-19, para. 11; *Spectrum Horizons NPRM*, 33 FCC Rcd 2438, 2473, para. 82.

³⁴⁴ *Use of Spectrum Bands above 24 GHz for Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd 8014, 8140-44, paras. 356-63 (2016) (*2016 Spectrum Frontiers R&O and FNPRM*). Separate from the leveraging of this beamforming technology for use in communications applications such as those being contemplated for 5G, some WPT applications contemplate utilizing directed RF energy to charge mobile devices from common household appliances such as washing machines. See *Could Your Washer Really Charge Your Smartphone From Across The Room?* at <http://www.engadget.com/2014/10/31/haier-energous-wireless-charging-really/>; see also <http://energous.com/technology/>; <http://www.witricity.com>.

³⁴⁵ Over the frequency range from 100 kHz through 6 GHz, our localized SAR limit for the general population is 1.6 W/kg as averaged over any one gram cube of tissue. (For occupational exposure over this same frequency range, the localized SAR limit is 8 W/kg as averaged over any one gram cube of tissue.) Similarly, at these frequencies, our whole-body SAR limit for the general population is 0.08 W/kg as averaged over the whole human body. (For occupational exposure, the whole-body SAR limit is 0.4 W/kg.) See 47 CFR § 1.1310(c): "The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube)." See also 47 CFR § 1.1310(b) for occupational limits.

³⁴⁶ TIA Comments at 34-35; Qualcomm Comments, GN Docket No. 14-177, at 15-16.

³⁴⁷ International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, 74 Health Physics 494 (1998); Institute of Electrical and Electronics Engineers, Inc. (IEEE), *Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005 (2006); Institute of Electrical and Electronics Engineers, Inc. (IEEE) *Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz*, IEEE Std C95.1-2019 (2019).

relative to the general population limits. We tentatively conclude not to adopt an extremity limit at this time.³⁴⁸

128. The proposed general population localized power density value of 4 mW/cm² matches the exposure limit specified at 6 GHz in the IEEE Std C95.1-1991 standard referenced in our rules.³⁴⁹ Our reading of the literature suggests that based on planar models, a power density of 4 mW/cm² just above 6 GHz is consistent with our 1-gram SAR limit of 1.6 W/kg at 6 GHz.³⁵⁰ Also, the thermal perception threshold at frequencies approaching 100 GHz for large areas of exposure is indicated at about 4 mW/cm².³⁵¹ Maintaining 4 mW/cm² across the entire frequency range (6 GHz to 3 THz) will avoid any potential discontinuity between SAR and power density limits at 6 GHz while also preventing the possibility of perception of warmth at higher millimeter wave frequencies.³⁵² We seek comment on all elements of this proposal. We seek comment on whether our lower-power exemptions above 6 GHz should be changed for a localized power density limit in this frequency range.³⁵³ Recognizing the ongoing work in standards bodies to establish limits on in-tissue power density in lieu of free-space power density—analogueous to SAR below 6 GHz—we also seek comment on whether we should instead adopt such a limit, and if so what that limit should be, or if we should withhold consideration of an in-tissue power density limit until after the standards have been published at a later date. Commenters may also propose other approaches for determining appropriate exposure limits at higher frequencies, with their analysis and justification for using any such protocol.

2. Averaging Area for Higher Frequencies

129. In the *2016 Spectrum Frontiers R&O and FNPRM*, the Commission acknowledged as reasonable a spatial averaging area of 20 cm² for power density above 10 GHz—as provided by ICNIRP for a whole-body exposure limit.³⁵⁴ However, as we continue to consider this issue, we find little support in the technical literature for specifying a large averaging area with respect to the whole-body limit when

³⁴⁸ In general, specific extremity limits are only used where the basic restriction is SAR. See 47 CFR § 1.1310. They are not used at higher frequencies where power density is the basic limit and exposure is a more local phenomenon. See *id.*

³⁴⁹ The American National Standards Institute (ANSI), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields*, 3 kHz to 300 GHz, ANSI/IEEE Std C95.1-1992, Sections 4.1 and 4.2 (1991).

³⁵⁰ Gustrau and Bahr, *W-Band Investigation of Material Parameters, SAR Distribution, and Thermal Response in Human Tissue*, IEEE Transactions on Microwave Theory and Techniques, Vol. 50, No. 10, October 2002 and Colombi et al, *Implications of EMF Exposure Limits on Output Power Levels for 5G Devices above 6 GHz*, DOI 10.1109/LAWP.2015.2400331, IEEE Antennas and Wireless Propagation Letters. Table VI in this paper shows a 1-gram SAR of 0.24 W/kg at 6 GHz due to a power density of 1 mW/cm² which implies a power density of 6.67 mW/cm² would result our 1-gram SAR limit of 1.6 W/kg. Also, calculations based on Appx. D, Table D-1, D-2, and D-5 in the *2013 RF Order and Notice*, imply continuity at 3.42 to 3.94 mW/cm². See *2013 RF Order and Notice*, 28 FCC Rcd at 3626-32.

³⁵¹ Blick et al, *Thresholds of Microwave-Evoked Warmth Sensations in Human Skin*, Bioelectromagnetics 18:403–409 (1997). Long duration (10-s), large area (327-cm²) sensation threshold of the human back was measured as 4.5 ± 0.6 mW/cm² at 94 GHz. See also, e.g., IEEE Std C95.1-2019 (allowing an epithelial power density limit of up to 4 mW/cm² for the general public with an averaging area of 1 cm² above 30 GHz if the exposed area on the body surface is small). FCC's power density exposure limits are defined as plane-wave equivalent. See 47 CFR § 1.1310.

³⁵² See *2016 Spectrum Frontiers R&O and FNPRM*, 31 FCC Rcd at 8141, paras. 359-60 (noting that a commenter had pointed out the discontinuity between the SAR and MPE limits at 6 GHz).

³⁵³ See *supra* Section IV.A (adopting the 1 mW exemption and MPE-based exemption).

³⁵⁴ See *2016 Spectrum Frontiers R&O and Further Notice*, 31 FCC Rcd at 8142-43, para. 363.

there is also stipulated an averaging area for a spatial maximum limit for localized exposure. Moreover, ICNIRP maintains an averaging area of 1 cm² for spatial maximum power densities over the frequency range of 10 GHz to 300 GHz. There is growing consensus that a range of from one to a few square centimeters would be a more appropriate averaging area for localized spatial maximum power density limits rather than the much larger values (20 cm² or 100 cm²)³⁵⁵ that are provided for the whole-body limits in recent published versions of technical standards.³⁵⁶

130. We propose that a 1 cm² averaging area be applicable to localized exposure conditions where the averaged power density would not exceed 4 mW/cm² for the general population or uncontrolled exposure (20mW/cm² for occupational or controlled exposure). The 1 cm² area is approximately the same size as any of the surfaces of a 1 g cube used for portable device SAR evaluation below 6 GHz,³⁵⁷ and we also note that 4 mW/cm² averaged over 1 cm² would result in similar exposure as the guidance that the FCC Laboratory currently offers to allow 1 mW/cm² to be averaged over 4 cm² for pertinent equipment authorizations.³⁵⁸ We invite comment on this proposal. We also seek comment on whether it may also be appropriate to specify a spatial peak limit coupled with this 1 cm² averaging area to avoid significant excursions under actual non-uniform exposure conditions on a millimeter scale.³⁵⁹ We are aware that this 1 cm² averaging area is generally smaller than the actual size of antenna arrays being contemplated for use by millimeter-wave portable devices, and we seek comment on whether this presents insuperable or significant difficulties, and on other technically valid and practical alternatives.

B. Transmitter-Based and Device-Based Time-Averaging

131. Our RF exposure limits for consumer devices allow for source-based time-averaging, that is, based on inherent properties of the source that are not controlled or affected by the user.³⁶⁰ This is typically a function of an on/off duty cycle that is fundamental to the underlying transmission protocol

³⁵⁵ Hirata, A., et. al., *Setting Exposure Guidelines and Product Safety Standards for Radio-Frequency Exposure at Frequencies Above 6 GHz: Brief Review*, Annals of Telecommunications, 74:17-24 (2019). See generally International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Draft ICNIRP Guidelines, Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (100 kHz TO 300 GHz), Appx. A: Review of Studies on Dosimetry*, section 3.3.2 (“Spatial averaging considerations”), p. 10, available at: https://www.icnirp.org/cms/upload/consultation_upload/ICNIRP_RF_Guidelines_PCD_Appx_A_2018_07_11.pdf (July 11, 2018). See also IEEE Std C95.1-2019 (specifying an averaging area of 4 cm² below 30 GHz and 1 cm² above 30 GHz).

³⁵⁶ International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, 74 Health Physics 494 (1998) (ICNIRP Guidelines 300 GHz); Institute of Electrical and Electronics Engineers, Inc. (IEEE), IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, IEEE Std C95.1-2005 (2006). But see IEEE, *Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz*, IEEE Std C95.1-2019 (2019).

³⁵⁷ 47 CFR § 1.1310(c).

³⁵⁸ See FCC Office of Engineering and Technology, Telecommunication Certification Body (TCB) Presentations, RF Exposure: Order/NPRM Issues at 12 (Oct. 2018), <https://transition.fcc.gov/oet/ea/presentations/files/oct18/5.1-TCB-RF-Exposure-OrderNPRM-Issues-MD.pdf>.

³⁵⁹ Hashimoto, Y., et. al., *On the Averaging Area for Incident Power Density for Human Exposure Limits at Frequencies Over 6 GHz*, Physics in Medicine and Biology, 62:3124-3138 (2017); see also *Use of Spectrum Bands above 24 GHz for Mobile Radio Services*, Notice of Proposed Rulemaking, 30 FCC Rcd 11878, 11974-75 para. 324 & n.574, (2015) (noting that no comments were received in response to our solicitation of comment on the adequacy of our 2013 exemption proposals based on a 1 cm² averaging area in preventing exposure over our limits, for example, in a situation involving multiple high-gain millimeter-wave radiators); *2013 RF Order and Notice* 28 FCC Rcd at 3539, para. 126.

³⁶⁰ 47 CFR §§ 2.1091(d)(2) and 2.1093(d)(5).

used to support a device's operation. Our rules do not specify a limit for temporal-peak maximum SAR or power density during any time-averaging period.³⁶¹ In Sections 2.1091(d)(2) and 2.1093(d)(5) of our existing rules, portable and mobile consumer devices generally may not use the 30-minute averaging time specified in Section 1.1310.³⁶² The rationale for restricting time averaging to source-based functions was that devices whose usage (and consequent power output) is controlled by consumers could not be guaranteed to operate only for the percentage of time upon which its time-averaged compliance was based.³⁶³ This computed average assumes continuous operation at maximum power and duty cycle, which is consistent with the maximum possible exposure over indefinite time periods.

132. In their comments to the *2013 RF Further Notice*, manufacturers asserted that the foreclosure of time-averaging the short bursts of data transmissions is unnecessarily constraining the capability to offer increasing data capacity for consumer devices, particularly when tested for compliance with zero spacing, such as for a notebook computer or a tablet used close to the body.³⁶⁴ Recent technology has been developed to allow for the optimization of the time-averaged transmit power of a device over a predefined time window, using past transmit power levels as a reference to determine the maximum time-averaged SAR over that period.³⁶⁵ Based on the device's own management of time-averaged SAR, a maximum allowable transmit power for a future fixed time interval would be determined, and the device would then operate at a power equal to or less than the maximum allowable transmitter power, depending on factors such as the amount of data to be transmitted and network conditions. The device would either back off from a higher transmitter power to a lower power when the calculated time-averaged SAR approaches the SAR limit, or it could transmit at a higher power when the device gains an additional margin between the calculated time-averaged SAR and the SAR limit. In considering such proposals and to be consistent with our established RF exposure limits, several questions related to this type of implementation need to be considered.

133. Many wireless devices (e.g., 4G LTE) transmit in short bursts that are variable depending on operational network and user demands. The present rules for source-based time-averaging do not account for the variable nature of such transmissions. The new technology being developed utilizes both the power level and time-averaging duration in a dynamic manner, depending on the device operating conditions, to determine SAR compliance in real-time.³⁶⁶ We propose that such active accounting and control of the instantaneous output power of the device be defined as *device-based time-averaging*, in our rules, because we expect, especially for portable devices with multiple transmitters, that the cumulative transmissions from all RF sources in the device be accounted for in the SAR margin calculations. We recognize that a device may have more than one RF source, some of which might be power-controlled by the device and others which might not, and so we seek comment on how to reliably and predictably

³⁶¹ This is consistent with NCRP Report 86, sections 17.4.3 and 17.4.8.

³⁶² An example described in our existing rules where source-based time averaging is appropriate would be consideration of the inherent transmission duty-cycle in determining exposure from a device that employs a time-division multiple-access (TDMA) scheme.

³⁶³ See generally, 1996 Order 11 FCC Rcd 15123. For example, push-to-talk capabilities cannot guarantee that a device would not be used over a longer period than assumed for the averaging or even for the entire 30-minute period, pushing the exposure over the average limit permitted.

³⁶⁴ See TIA Comments at 9-11, Qualcomm Reply Comments at 1, CTA Comments at 4, 9-10, MWF Comments at 28-29, and HP Comments at 1-2.

³⁶⁵ Real-Time Specific Absorption Rate Implementation in Wireless Devices, U.S. Patent No. 9,622,187 B2 (issued April 11, 2017).

³⁶⁶ For example, a device could temporarily increase power to accommodate a high upload rate and/or poor propagation conditions, and then reduce power during less demanding periods based on the available SAR margin for the designated time-averaging period.

distinguish any such device from a conventional device intending to be certified under our existing source-based time-averaging rules.

134. We seek comment on whether to permit this device-based time-averaging where the instantaneous transmit power and duration of each transmission burst can be managed by the device over some time period in a way that will ensure compliance with the RF exposure rules. We also seek input as to what specifications we should adopt that will confirm compliance and be applied clearly and consistently to devices coming on the market. We propose to allow a practical extension of our existing “source-based” definition in our rules to include “device-based” time-averaging. By adding this definition, we distinguish such a device from those already being authorized and recognize its responsiveness and applicability to an individual RF source while compliance is ultimately controlled by the device based on the device tracking transmission bursts and power levels over time.

135. It is unclear how SAR measurement results based on static conditions at certain power levels may be applied to evaluate device compliance for dynamic conditions where both operational and user exposure conditions are continuously changing. It will be necessary to select the various parameters for applying device-based time-averaging to non-periodic transmissions that are apparently random and dynamic, which can be influenced by device operating configurations, network and propagation conditions and user operating conditions to ensure that the final measured exposure values still provide sufficient margins for various use configurations. We seek comment on the range and type of parameters that need consideration to apply the proposed time-averaging principles. For example, is it possible to develop one or more standard transmission sequences that would reasonably replicate typical operating conditions? Alternatively, would the averaging be demonstrated through representations of the device’s software and how would this be validated? How do we ensure the device software/firmware achieves compliance? We seek comment on the above and any other factors as they may relate to consideration of device-based time-averaging in the equipment authorization process.

136. With respect to the appropriate time-averaging period, we note two references for specifying time-averaging limits: (1) the ICNIRP standard provides for averaging over 6 minutes at 10 GHz and reduces to 10 seconds at 300 GHz on a complex basis,³⁶⁷ and (2) the IEEE standard has an averaging time of 25 minutes at 6 GHz dropping to 10 seconds at 300 GHz.³⁶⁸ However, since we do not limit temporal-peak SAR or power density, all the energy available in a time-averaging period could be deposited in a moment resulting in a well-defined temperature rise and be compliant with the rules. Thus, using the extended time-averaging periods of 6 minutes or 30 minutes set forth in our rules in other contexts or either of the alternative time windows specified by ICNIRP and IEEE could allow for inappropriate temperature rises in extreme cases when intense exposure occurs only for a brief period. By reducing the time-averaging period, the maximum possible temperature rise can be limited to a reasonable quantity. The potential temperature rise (ΔT) due to an impulse exposure is proportional to the product of the allowed continuous-spatial-peak SAR (SAR_{csp}) and the time-averaging period (Δt), so that a maximum time-averaging period (Δt) can be calculated from a specified temperature rise (ΔT) from $\Delta t = c \cdot \Delta T / SAR_{csp}$ where c is the specific heat of tissue. SAR_{csp} at higher frequencies occurs at the skin surface, depends on the SAR or power density limit (for this calculation 1.6 mW/g or 4.0 mW/cm²) and on the depth of energy absorption into tissue, and this depth in turn depends on frequency. Determination

³⁶⁷ International Commission on Non-Ionizing Radiation Protection (ICNIRP), *Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (Up to 300 GHz)*, 74 Health Physics 494 (1998).

³⁶⁸ Institute of Electrical and Electronics Engineers, Inc. (IEEE), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, IEEE Std C95.1-2005, (2006); see also IEEE, *Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz*, IEEE Std C95.1-2019 (2019).

of SAR_{esp} was approached with standard calculations using a planar model of uniform dry skin.³⁶⁹ Based on this approach, 100 seconds is a supportable averaging time up to about 3 GHz, with smaller averaging times down to a second at higher frequencies. This would permit a device to actively track its RF emissions while limiting potential temperature rise in tissue due to an impulse to value of about 0.1 °C, less than would be perceptible by the general population.³⁷⁰ Therefore, we propose and seek comment on the following maximum time windows to be allowed for any frequency for devices seeking to implement device-based time-averaging techniques:

Table 3 – Proposed Maximum Averaging Times for Device-Based Time-Averaging.

Frequency (GHz):	< 2.9	2.9-7.125	7.125-10.5	10.5-15.4	15.4-24	24-37	37-53	53-95	> 95
Time (seconds):	100	49	27	14	7	4	3	2	1

In deriving this table, as a matter of simplicity and practicality, we looked at the bands and bandwidth we expect will be used for various types of devices and services, and provide distinct parameters for each frequency range. Comments are welcome on this approach and whether we have best delineated the frequency ranges for the purpose of time-averaging limits. Any comment should include a rigorous technical analysis in support of the position it advocates.

C. Wireless Power Transfer Devices

137. A characteristic example of the technical advancement of wireless devices is the development and evolution of wireless power transfer devices. Such devices are not intended for communications, but instead allow for the transmission of electrical energy without the use of wires or other physical connections. Specifically, the primary device is a transmitting unit that conveys RF energy to one or several secondary devices that act as receiving units, to charge or power the receiving unit. The most familiar consumer applications of wireless power transfer technology are charging pads or fixtures for charging the batteries in cell phones, electronic toothbrushes, kitchen appliances, and cordless tools. Most of these products have been designed to operate via magnetic induction³⁷¹ or resonance³⁷² techniques, where the device is placed on a charger with little or no distance separation between the power source (transmitting unit) and the battery or appliance (receiving unit). Most of the existing applications are for battery charging, and charge only one device at a time and at low power. However, use of wireless power transfer for powering of devices and charging of multiple devices at once is increasing, and charging (or powering) of devices while in motion is being developed.

³⁶⁹ Kenneth R. Foster et al, *Thermal Response of Human Skin to Microwave Energy: A Critical Review*, 111 Health Phys. 528–541 (2016).

³⁷⁰ Kenneth R. Foster et al, *Heating of Tissues by Microwaves: A Model Analysis*, 19 Bioelectromagnetics 420–428 (1998) and Joseph C. Stevens and Kenneth K. Choo, *Temperature Sensitivity of the Body Surface over the Life Span*, 15 Somatosensory & Motor Research 13-28 (1998).

³⁷¹ A typical *magnetic inductive* wireless power transfer system has two separate components: a transfer unit, or “charger”, which connects to a wall outlet and a receiver (the “charged” unit, which receives the power). Radio frequency (RF) energy generated in a coil circuit (primary coil) in the charger is coupled through the air to another functional coil circuit (secondary coil) residing in the receiving unit where it is used to charge a battery circuit, or to directly power different components. There is no wire between the charger and charged devices.

³⁷² In wireless power transfer using *magnetic resonance*, the two coils from the charger and charged devices resonate at the same frequency to enhance the efficiency of the magnetic coupling despite the greater distance between them. Because other receiving coils (or any other object for that matter) would not resonate at the same frequency as the transfer coil in the absence of intentional and precise tuning, only the targeted receiving unit can be charged, making power transfer highly selective even at a distance.

138. Certain new wireless power transfer applications, while designed for relatively close coupling between the transmitting and the receiving units, can operate at very high power (e.g., higher than 3 kW and up to several tens of kW), and at a variety of frequencies below 100 kHz.³⁷³ Other advanced wireless power transfer applications can provide charging from a transmitting unit to one or more receiving unit(s) located at greater distances (one meter or more) from the transmitting unit, with future developments intended at distances suitable for room-size operation, and while the receiving unit is in motion.³⁷⁴ These new devices also create significant measurement challenges since the beam forming provided by the antenna technologies is dynamic and can vary in time and space based on the detection of obstruction between the transmitting and receiving units.³⁷⁵

139. *Definition.* Wireless power transfer devices have been authorized for several years under the Commission's Part 15³⁷⁶ and Part 18³⁷⁷ rules, depending on whether any communication function is involved between the transmitting and receiving units.³⁷⁸ As these new and enhanced wireless power transfer products, currently under development, will seek a ubiquitous position in modern households and workplaces and will require unique considerations in our equipment authorization process, we propose to define wireless power transfer devices under Part 18 of our rules as:

A category of ISM equipment which generates and emits RF energy for local use by inductive, capacitive or radiative coupling, for transfer of electromagnetic energy between a power transfer unit (TU) and receiving unit(s) (RU) of a Wireless Power Transfer (WPT) system.

140. We seek comment on the proposed definition. Is there an alternative definition that would better reflect the technological developments in this area? We also seek to allow limited non-communications feedback—for example, the receiving unit modulates its resistance to create a “feedback” to the transmitting unit to indicate its charge level—as compliant with Part 18 rules.³⁷⁹ Based on our discussion of wireless power transfer *locally operated* and *at-a-distance* devices below, should we also consider a separate definition for wireless power transfer equipment that provides charging of

³⁷³ For example, the Society of Automotive Engineers SAE Surface Vehicle Information Report J2954 (Nov 2017) for light-duty vehicles (e.g., cars), specifies a common operating frequency range of 81.38 kHz to 90.00 kHz. See https://www.sae.org/standards/content/j2954_201605/. Certain international standards specify various frequency ranges for WPT in general. See ETSI EN 303 417 V1.1.1 (2017-09), *Wireless power transmission systems, using technologies other than radio frequency beam in the 19-21 kHz, 59-61 kHz, 79-90 kHz, 100-300 kHz, 6765-6795 kHz ranges*; *Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU* (Sept. 2017).

³⁷⁴ See e.g., <http://www.energous.com>; <http://www.ossia.com>.

³⁷⁵ See, e.g., Energous Corporation, FCC ID 2ADNG-MS300.

³⁷⁶ 47 CFR §§ 15.1 *et seq.*; see, e.g., Powercast Corporation, FCC ID YEST91503. WPT devices may operate under Part 15 of the Commission's rules as generic unlicensed devices.

³⁷⁷ 47 CFR §§ 18.1 *et seq.*; see, e.g., Energous Corporation, FCC ID 2ADNG-MS300. WPT devices may operate under Part 18 of the Commission's rules under the category “miscellaneous ISM equipment”. 47 CFR § 18.305(b).

³⁷⁸ To address WPT power transfer at a distance, the OET Laboratory has been providing guidance on a case-by-case basis. See, e.g., Energous Corporation, FCC ID 2ADNG-MS300. Also, OET has provided general guidance through KDB publications for compliance with our rules on nascent or evolving technologies such as WPT. The OET Laboratory will continue to provide guidance on WPT until final rules are adopted.

³⁷⁹ Section 18.107(c) defines ISM equipment as “[e]quipment or appliances designed to generate and use locally RF energy for industrial, scientific, medical, domestic or similar purposes, *excluding applications in the field of telecommunication*,” 47 CFR § 18.107(c) (emphasis added,) therefore, data transmission for communications purposes is prohibited for ISM equipment. However, the Commission has issued guidance to allow such limited communications under Part 18 rules for WPT equipment. See KDB Publication 680106 at <https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=41701&switch=P>.

receiving units located at a distance from the transfer unit, as this type of equipment may not meet the above proposed definition for “local” operation? We invite comments and input on these issues.

141. *Locally operated wireless power transfer system.* Part 18 allows the use of potentially unlimited power if a device operates within a designated Industrial, Scientific and Medical (ISM) frequency band,³⁸⁰ so long as the device operates “locally.”³⁸¹ Because the rules do not define what would constitute “local” usage, measurement and compliance challenges arise in assessing wireless power transfer devices that provide charging of receiving units located at a distance from the wireless power transfer transmitting unit. We seek comment on whether the term “local” should be defined in terms of distance between the transmitting and receiving units. If we define “local” based on this distance, what is the maximum distance between the transmitting and receiving units that should be considered as “local” operation?

142. We note that CISPR³⁸² is considering a definition for the primary device of a wireless power transfer system that states that the term “local” is used differently in the context of wireless power transfer from other ISM devices: “for the case of WPT systems that operate inductively, ‘local’” may imply that the separation distance between the primary (TU) and secondary (RU) WPT devices should not be greater than 50 centimeters (cm).³⁸³ Based on CISPR’s proposal, should we use 50 cm as the maximum distance for wireless power transfer devices that operate “locally” (excluding wireless power transfer at-a-distance devices, as discussed below) under Part 18?

143. *Wireless power transfer at-a-distance.* We seek comment on a suitable definition and operating parameters for wireless power transfer devices that provide charging of receiving units located at a distance from the power transfer unit (*i.e.*, 50 cm or greater), with future developments intended at distances suitable for room-size operation, and while the RU is in motion.³⁸⁴ This would cover wireless

³⁸⁰ There are eleven (11) designated ISM frequency bands with specific bandwidths. *See* 47 CFR § 18.301.

³⁸¹ 47 CFR § 18.107 requires ISM equipment “to generate and use locally RF energy.” The Commission’s rules as well as other international standards do not quantify a specific distance for the term “local.” The reason to limit RF energy to “local use” in Part 18 is to prevent high-power RF energy reaching outside the immediate vicinity of the RF generator source, which is allowed to operate at unlimited power to perform “work” (non-communication functions) within the designated ISM frequency bands. *See* 47 CFR § 18.305(a). Microwave ovens are probably the best-known example of ISM consumer equipment in that they generate RF energy and use that energy locally to heat food within the shielded oven structure. We note that CISPR has been actively involved in this area, *see, e.g.*, CIS/B/710/CD (Aug. 2018), in which a “local” distance for WPT device should not be greater than 50 centimeters (~20 inches). A proposal is also being considered by CISPR for WPT at-a-distance devices, proposing distances up to 10 meters (30 feet) between the transmitting and the receiving units. In addition, so-called “wireless power transmission” has been under consideration in ITU-R since the 1997 initiation of their ongoing Communication Study Group 1, ITU-R 210 3/1, <http://www.itu.int/pub/R-QUE-SG01.210>.

³⁸² CISPR (Comité International Spécial des Perturbations Radioélectriques in French, International Special Committee on Radio Interference in English) is a standards setting body that is part of the International Electrotechnical Commission (IEC), which established international standards to control electromagnetic interference in electrical and electronic devices.

³⁸³ *See* CIS/B/710/CD, Committee Draft, “Amendment 3 Fragment 1 to CISPR 11 Ed. 6: Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement - Requirements for air-gap wireless power transfer (WPT),” (August 2018); ; CIS/B/717/CC, “Compilation of Comments on CIS/B/710/CD,” (October 2018).

³⁸⁴ *See e.g.*, Office of Engineering and Technology Seeks Comment on Auspion USA, Inc. Request for Waiver of ISM “Local Use” Requirement in Parts 2 and 18 for a 24 GHz Wireless Power Transfer Device Over Distance, DA 19-211 (OET Mar. 26, 2019). GuRu (formerly Auspion) requests to operate a wireless charging system using the 24 GHz ISM band to charge receiving devices located at distances greater than 3 feet (1 meter) from the charging unit. GuRu is effectively requesting the Commission to waive the “local” definition to allow ISM devices that “...employ phased arrays [antennas] to focus the energy within a small volume of space at a defined location within

(continued....)

power transfer devices that do not meet the definition of a locally operated wireless power transfer device, *i.e.*, within a proposed maximum distance between the transmitting and receiving unit(s) as discussed above. Should we consider the size and coherence of the electromagnetic field created, rather than its distance from the transmitting unit? The challenge with these types of wireless power transfer devices is that charging at a distance can create an RF field distribution in three dimensions with an undefined or varying beam shape depending on the design. Moreover, the location of maximum RF exposure will be an area where various beams intersect, and the direction/location and intensity of the beams can change with the location of the target receiving unit(s). Instead—or in addition—should the size and/or shape of the maximum field determine whether the energy is used in reference to the distance between the transmitting unit and any receiving unit(s)? What parameters should be used for such a consideration?

144. We further seek comment on what factors we should consider to ensure that the RF beam from the transmitting unit is closely concentrated at the receiving unit, such that RF energy along the path(s) does not exceed our limits for RF exposure to potential human bodies or create potential for harmful interference to other services. How should we evaluate compliance of wireless power transfer at-a-distance devices with potential movements of humans in the RF field and the potential for very close proximity of the receiving unit to humans?³⁸⁵ We believe that these devices should comply with our rules under all operating conditions, including movements of people around and in the field. Should we propose to establish frequency bands and power limits specifically for wireless power transfer at-a-distance devices either under Part 15 or Part 18 of our rules, including operation in designated ISM bands (instead of allowing unlimited power in these bands, as Part 18 currently permits)?³⁸⁶ If we do establish power limits, what should be the basis for such limits and should there be any consideration for potential harmful interference to other non-part 18 devices given the popularity of these frequency bands for consumer devices?³⁸⁷ With respect to the potential for harmful interference from wireless power transfer devices to active medical devices that may be worn or implanted (*e.g.*, body worn insulin pumps, implantable cardiac pacemakers, implantable deep brain stimulators (DBS), spinal cord stimulators), what mitigation techniques should be required?³⁸⁸

145. Finally, we seek input on the following issues:³⁸⁹ Under what category of spectrum use should we consider wireless power transfer, *e.g.*, either ISM under Part 18, Part 15, or new rule part?

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a relatively short distance (approximately a few meters [more than 1 meter])” to operate under Part 18 ISM definition.

³⁸⁵ We expect that there may be devices intended to charge a cellphone while in a pocket, and as the owner moves around in a room.

³⁸⁶ CISPR 28:1997, Technical Report, *Industrial, scientific and medical equipment (ISM) – Guidelines for emission levels within the bands designated by the ITU*, (1997).

³⁸⁷ For example, Wi-Fi devices operate under 47 CFR § 15.247 in the 2400–2483.5 GHz band, which is also an ISM band.

³⁸⁸ See Letter from Jeffrey Shuren, M.D., J.D., Director, Center for Devices and Radiological Health, Food and Drug Administration, Department of Health and Human Services, to Julius Knapp, FCC, (dated April 24, 2019) (*FDA Letter*) at 2 (suggesting that “the most effective mitigation against EMI to active medical devices from the emissions of WPT devices is to reduce the WPT emissions and thus medical device exposure. The methods to reduce exposure should include limits on the WPT output power, designing the WPT with safety interlocks (*i.e.*, designing the WPT source so that it can detect the presence of humans or animals and shut off or greatly reduce power output), creating exclusion zones, and recommending separation distances between the WPT emitter and any active medical devices.”)

³⁸⁹ These issues are also being considered in the International Telecommunications Union (ITU) Radio Communication Study Group 1, ITU-R 210 3/1, <http://www.itu.int/pub/R-QUE-SG01.210>.

What radio frequency bands are most suitable for wireless power transfer?³⁹⁰ What steps are required to ensure that radiocommunication services, including the radio astronomy service, as well as active medical devices, as indicated above, are protected from wireless power transfer operations?

146. *Certification.* Under Part 18, wireless power transfer equipment is currently authorized pursuant to the Supplier's Declaration of Conformity (SDoC)³⁹¹ rules (formerly the Declaration of Conformity rules), with the option to use the Certification³⁹² rules.³⁹³

147. Because of the continuing evolution of wireless power transfer technology, and the potential use at higher power and in closer proximity to humans, we propose to require wireless power transfer equipment for both consumer and non-consumer applications to be subject to our Certification rules.³⁹⁴ Certification will allow the Commission to ensure that the devices comply with our RF exposure rules which may be achieved by determining whether either an RF exposure exemption applies or a routine RF exposure evaluation is required.³⁹⁵ The FCC Laboratory presently provides guidance that requires applicants for authorization of wireless power transfer devices to consult with the FCC Laboratory on measurement procedures prior to equipment authorization, but exempts certain low-power wireless power transfer devices from this requirement.³⁹⁶ These low-power wireless power transfer

³⁹⁰ We note that Toyota Motor North America, Inc., Ford Motor Company, BMW of North America LLC, and Nissan North America, Inc. (Toyota et al.) has submitted a joint Petition for Rule Making, requesting to operate WPT charging for light-duty electric vehicles in the 79-90 kHz frequency band, at emission limits higher than what Part 18 is allowing in this band. *See* Toyota et al., Petition for Rule Making for Amendment of the Commission's Rules to Allow Next-Generation Wireless Charging Technology for Electric Vehicles Under Part 18 (filed Sept. 5, 2018), RM-11815, <https://www.fcc.gov/edocs/search-results?t=advanced&dockets=11815>. We note that the petition received several supporting comments; with one opposition from ARRL (stating that "the precise subject of this Petition is in the early stages of international study and evaluation, and the soonest that the subject will be addressed internationally on any comprehensive level is at the 2019 World Radiocommunication Conference ("WRC-19)").

³⁹¹ Supplier's Declaration of Conformity (SDoC) is a procedure that requires the party responsible for compliance ensure that the equipment complies with the appropriate technical standards. *See* 47 CFR § 2.906. The responsible party, who must be located in the United States, is not required to file an equipment authorization application with the Commission or a Telecommunication Certification Body (TCB). *See* 47 CFR § 2.909. Equipment authorized under the SDoC procedure is not listed in a Commission database. However, the responsible party or any other party marketing the equipment must provide a test report and other information demonstrating compliance with the rules upon request by the Commission. *See* 47 CFR § 2.938. The responsible party has the option to use the certification procedure in place of the SDoC procedure. *See* 47 CFR § 2.906(c).

³⁹² Certification is the most rigorous approval process for RF devices that have the greatest potential to cause harmful interference to radio services. It is an equipment authorization issued by an FCC-recognized TCB based on an evaluation of the supporting documentation and test data submitted by the responsible party (e.g., the manufacturer or importer) to the TCB. *See* 47 CFR § 2.907. Testing is performed by an FCC-recognized accredited testing laboratory. *See* 47 CFR § 2.948. Information including the technical parameters and descriptive information for all certified equipment is posted on a Commission-maintained public database. In addition, equipment subject to approval using the SDoC procedure can optionally use the Certification procedure. *See* 47 CFR § 2.906(c).

³⁹³ *See* 47 CFR § 18.203.

³⁹⁴ *See* 47 CFR pt. 2, Subpart J.

³⁹⁵ *See* 47 CFR §§ 2.1091 & 2.1093. The Commission maintains a database of all RF equipment certified by the Commission and TCBs. This database allows the Commission to verify that a device is approved without having to contact the TCB or the manufacturer to obtain the records demonstrating compliance with the FCC requirements. The database also provides a single publicly available source of information that parties can use to verify approvals and obtain copies of applications for and grants of certification. *See* <http://www.fcc.gov/oet/ea/>.

³⁹⁶ KDB Publication 680106.

devices include those that operate on frequencies below 1 MHz, at power levels less than 15 watts, only in mobile device exposure condition (> 20 cm from the body), and only use single primary and secondary coils in close proximity. We seek comment on whether we should adopt a rule to exempt such low-power wireless power transfer devices from requiring certification and instead allow them to continue to be authorized using our SDoC procedure. In addition, are there other criteria we should consider when exempting wireless power transfer devices from the certification requirement, if so, what are they and why?

VI. MEMORANDUM OPINION AND ORDER

148. Lastly, in this *Memorandum Opinion and Order*, we address a petition for reconsideration (*Petition*) filed by the American Association for Justice (AAJ).³⁹⁷ AAJ seeks reconsideration of a portion of the Commission's 2013 *RF Order and Notice* relating to the classification of the pinnae (outer ears) as extremities for purposes of testing compliance with our RF emission limits for human exposure.³⁹⁸ In the 2013 *RF Order and Notice*, the Commission adopted rules classifying the pinnae in the same manner as other bodily extremities³⁹⁹ for purposes of evaluating localized specific absorption rates (SAR).⁴⁰⁰ On July 1, 2013, AAJ submitted its *Petition* objecting to this change. Oppositions to the *Petition* were filed by four parties.⁴⁰¹

149. Pursuant to the Commission's rules, any interested person may petition for reconsideration of a final action in a rulemaking proceeding.⁴⁰² Reconsideration may be denied where a petitioner fails to present facts and arguments unconsidered by the Commission⁴⁰³ or in an action by a Bureau or Office where the petitioner fails to identify a material error or omission in the original order, raises additional facts or arguments not known or not existing until after the petitioner's last opportunity to respond, or relies on arguments that have been fully considered and rejected by the Commission within the same proceeding.⁴⁰⁴ As discussed below, the AAJ petition for reconsideration does not raise new facts

³⁹⁷ Petition of the American Association for Justice for Reconsideration of Pinna Classification, ET Docket No. 03-137 (filed on July 1, 2013), <https://www.fcc.gov/ecfs/filing/6017456259/document/7520927003> (*Petition*).

³⁹⁸ *Id.* at 2.

³⁹⁹ "Extremities" is a non-technical term that is only used to collectively identify certain body parts distinguished from the whole body for purposes of allowable peak spatial-average SAR limits. In addition to the pinnae, hands, wrists, feet, and ankles are considered "extremities." 47 CFR § 1.1310(b).

⁴⁰⁰ See *Order*, Section III.A.3., Pinna (Outer Ear) Classification as an Extremity, 28 FCC Rcd 3514-3517, para. 42-50 (2013).

⁴⁰¹ Opposition to Petition for Reconsideration from James Edwin Whedbee, ET Docket No. 03-137, at 4 (filed July 1, 2013), <https://www.fcc.gov/ecfs/filing/6017456364/document/7520927134>; Opposition to Petition for Reconsideration from CTIA – The Wireless Association, ET Docket No. 03-137, at 3 (filed September 11, 2013) <https://www.fcc.gov/ecfs/filing/6017466697/document/7520942994>; Opposition to Petition for Reconsideration from Telecommunications Industry Association, ET Docket No. 03-137, at 2 (filed September 11, 2013) <https://www.fcc.gov/ecfs/filing/6017466679/document/7520942974>; Opposition to Petition for Reconsideration from Mobile Manufacturers Forum, ET Docket No. 03-137, at 3 (filed September 10, 2013) <https://www.fcc.gov/ecfs/filing/6017466542/document/7520942819>. Inasmuch as our rejection of the *Petition* is consistent with the position of these opposition pleadings, we forego any further discussion of them here.

⁴⁰² 47 CFR § 1.429(a); see 47 U.S.C. § 405(a) (stating that "[a]fter an order, decision, report, or action has been made or taken in any proceeding by the Commission . . . , any party thereto, or any other person aggrieved or whose interests are adversely affected thereby, may petition for reconsideration").

⁴⁰³ See 47 C.F.R. § 1.429(b).

⁴⁰⁴ See 47 C.F.R. § 1.429(l).

or arguments, nor does it demonstrate any errors or omissions in the Commission's previous decision.⁴⁰⁵ Furthermore, while the relevant docket, ET No. 03-137, had been open since 2003, AAJ presented its petition and accompanying arguments following the adoption of the *2013 RF Order and Notice*. In its petition for reconsideration, AAJ did not present facts and arguments that it could not have presented much earlier by exercise of ordinary diligence. Since AAJ's petition for reconsideration does not meet the regulatory requirements for being granted, we dismiss and, in the alternative, deny it.

150. AAJ argues that treating the pinnae as extremities is likely to lead to greater exposure to the head, which it contends is a health risk.⁴⁰⁶ It devotes much of its *Petition* to discussing potential health risks to children and adults, arguing that there is a nexus between RF exposure to the pinnae and adverse health effects due to its proximity to the brain.⁴⁰⁷ The *Petition* also includes general statements concerning the increasing use of cell phones, challenges Commission reliance on data from "an organization populated by industry insiders" [the IEEE], and exhorts the Commission to review recent RF cancer epidemiology.⁴⁰⁸ It specifically argues that the Commission should "re-examine the standards limiting radiofrequency (RF) energy emitted by cell phones [and] ... ameliorate uncertainty surrounding human exposure to RF radiation."⁴⁰⁹ The AAJ concludes its *Petition* by urging the FCC to commit to a more robust exploration into the area of health and RF exposure.⁴¹⁰

151. We agree that examining the continued propriety of our RF exposure standards has been appropriate; indeed, such an examination was undertaken and was underway even as AAJ filed its petition.⁴¹¹ However, the *2013 RF Order and Notice* discussed in detail how the pinnae have similar anatomical tissue compositions and thermal tolerances to other extremities and why these similarities warranted the pinnae's classification as extremities,⁴¹² and AAJ has not substantively disputed this reasoning.

152. AAJ's *Petition* contains no new information or arguments that specifically address the effects of RF exposure on the pinnae themselves and otherwise relies on arguments that have been fully considered and rejected. While the AAJ suggests that the pinnae are fundamentally different from other extremities due to its proximity to the brain, the AAJ has not demonstrated scientifically or quantitatively why that proximity is material for SAR limits that are based solely on localized thermal effects. Moreover, AAJ's arguments about the pinnae's proximity to the brain were addressed in the *2013 RF Order and Notice*.⁴¹³ Classifying the pinnae as extremities did not change the fact that for the head, SAR

⁴⁰⁵ Moreover, AAJ, couches its argument in terms of the "consideration of costs" standard of review set forth in *Chamber of Commerce v. SEC*, 412 F.3d 133, 142-43 (D.C. Cir. 2005), and argues that cost-benefit analysis indicates that the FCC does not possess the adequate authority to promulgate its Order and the proposed reclassification of the pinnae. This case is irrelevant to our consideration. The "consideration of costs" standard (1) is based on the specific statutory language of the Investment Company Act of 1940, which regulates funds that engage primarily in investing, reinvesting, and trading in securities; and (2) applies only to rulemaking actions by the SEC. *See* 15 U.S.C. § 80a-2(c).

⁴⁰⁶ *Petition* at 2.

⁴⁰⁷ *Petition* at 4.

⁴⁰⁸ *Petition* at 2.

⁴⁰⁹ *Petition* at 1.

⁴¹⁰ *Petition* at 8.

⁴¹¹ *See RF Order and Notice*, 28 FCC Rcd at 3570, para. 205.

⁴¹² *See id.* at 3515, para. 48.

⁴¹³ AAJ's petition relied on arguments that have been fully considered and rejected by the Commission within the same proceeding, rendering the petition procedurally defective and appropriate for dismissal. *See* 47 C.F.R. § 1.429(l)(3).

limits were retained at the more stringent 1.6 W/kg, averaged over any one-gram cube of tissue.⁴¹⁴ Additionally, as we stated in our decision, before the pinnae's classification as extremities, standard evaluation procedures for SAR compliance did not measure or calculate RF exposure in the pinnae, but measured RF exposure *within* a test mannequin head.⁴¹⁵ The *2013 RF Order and Notice* noted that the pinnae classification "has no practical effect on human exposure," and that "devices that meet the localized SAR limits applicable to the head will typically meet the SAR limit for extremities with respect to the pinna[e]."⁴¹⁶ Furthermore, the AAJ does not offer the Commission previously unpresented arguments when it cites alternative concerns related to pinnae classification, brain proximity, and human safety. The *2013 RF Order and Notice* took note of a number of comments concerning possible "non-thermal" biological effects of RF and the brain, but rationally excluded considering these "non-thermal" effects when classifying the pinnae as extremities for SAR compliance, limiting the decision to the consideration of tissue composition and thermal properties only within the pinnae themselves, alongside the support of expert determinations of the FDA and of the IEEE, while deferring such other "non-thermal" considerations raised for consideration in our *Inquiry*.⁴¹⁷ In terminating our *Inquiry*, we have rigorously analyzed our existing RF exposure framework and have dismissed the notion that the existing framework should be altered on account of any "non-thermal" effects.⁴¹⁸

153. The AAJ offers no persuasive evidence that the Commission's analysis is flawed. AAJ argues that analysis the Commission relied on from the IEEE analysis on pinnae classification is outdated merely because the C95.1 standard was adopted in 2006. It correctly states "mobile phone and wireless technology have undergone substantial changes" in the past decade.⁴¹⁹ Nowhere, however, does AAJ quantitatively specify how particular technological changes should affect SAR classifications for the pinnae. As recognized in the *2013 RF Order and Notice*, the IEEE developed the only substantial record on the subject, and while AAJ claims (without substantiation) that IEEE is biased,⁴²⁰ that record has the current support of federal health and safety agencies, including the Food and Drug Administration (FDA) Center for Devices and Radiological Health.⁴²¹ While AAJ relies on studies and other information from the IARC and the National Cancer Institute, among others, the Commission recognizes that it is not a health and safety agency, and necessarily gives considerable weight to the expertise of agencies and groups, like the FDA and IEEE, who can interpret the biological research necessary to assess the health impact of RF emissions and determine what exposure levels can be considered safe for humans. Based on the record and the views of these expert agencies and groups, we find no merit in AAJ's petition.

154. To conclude, both the *Petition*'s contents and the timeliness of its arguments do not warrant a grant. Accordingly, we dismiss and alternatively deny the petition for reconsideration.

⁴¹⁴ See *RF Order and Notice*, 28 FCC Rcd at 3514, para. 44.

⁴¹⁵ *Id.* at 3516, para. 49.

⁴¹⁶ *Id.*

⁴¹⁷ *Id.* at 3515, para 46 & n.84, citing EMR Network comments, ET Docket No. 03-137, at 3-4, EMR Network reply comments at 1-2.

⁴¹⁸ See *Termination of Notice of Inquiry*, *supra* para. 10.

⁴¹⁹ *Petition* at 4.

⁴²⁰ AAJ did not present evidence that IEEE is biased. We reject this assertion and note that the IEEE (1) is the world's largest association of technical professionals; (2) has a diverse membership of 423,000 members in over 160 countries around the world, with members from a wide range of disciplines, and balanced representation from the medical, scientific, engineering, industrial, governmental, and other communities; (3) is composed of leading experts in the field of RF emissions with the roots of the organization having originally formed out of the Institute of Radio Engineers; and (4) follows an open consensus process.

⁴²¹ See *RF Order and Notice*, 28 FCC Rcd. at 3514, para. 45 (2013).

VII. PROCEDURAL MATTERS

155. *Paperwork Reduction Analysis.* This *Second Report and Order* contains new information collection requirements. subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. OMB, the general public, and other Federal agencies are invited to comment on the new information collection requirements contained in this proceeding. In addition, we note that pursuant to the Small Business Paperwork Relief Act of 2002 (SBPRA), Public Law 107-198, *see* 44 U.S.C. 3506(c)(4), we previously sought specific comment on how the Commission might further reduce the information collection burden for small business concerns with fewer than 25 employees.

156. With regard to the *Second Report and Order*, we have assessed the effects of various changes and clarifications, and consistent with the previous review of how our proposals might impose information collection burdens on small business concerns, we anticipate no adverse impacts on small business concerns with fewer than 25 employees.

157. The Notice of Proposed Rulemaking also contains proposed information collection requirements. The Commission, as part of its continuing effort to reduce paperwork burdens, invites the general public and OMB to comment on the information collection requirements contained in this document, as required by the Paperwork Reduction Act of 1995, Public Law 104-13. In addition, pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. 3506(c)(4), we seek specific comment on how we might further reduce the information collection burden for small business concerns with fewer than 25 employees.

158. *Congressional Review Act.* The Commission will send a copy of this Second Report and Order to Congress and the Government Accountability Office pursuant to the Congressional Review Act, *see* 5 U.S.C. 801(a)(1)(A).

159. *Initial Regulatory Flexibility Analysis.* As required by the Regulatory Flexibility Act of 1980, as amended (RFA),⁴²² the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities of the proposals addressed in this NPRM. The IRFA is set forth in Appendix C. Written public comments are requested on the IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments on the NPRM. The Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, will send a copy of the NPRM, including the IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).⁴²³ In addition, the NPRM and IRFA (or summaries thereof) will be published in the Federal Register.⁴²⁴

160. *Final Regulatory Flexibility Analysis.* The Regulatory Flexibility Act (RFA) 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." According, we have prepared Final Regulatory Flexibility Analysis concerning the possible impact of the Second Report and Order on small entities. The Final Regulatory Flexibility Analysis is set forth in Appendix D.

161. *Ex Parte Presentations.* All requests for meetings with Commission staff regarding these Dockets should be via email to Martin.Doczkat@FCC.Gov. Those who lack Internet access may direct their requests by phone to 202-418-2470.

⁴²² *See* 5 U.S.C. § 603.

⁴²³ *See* 5 U.S.C. § 603(a).

⁴²⁴ *See id.*

162. This proceeding shall be treated as a “permit-but-disclose” proceeding in accordance with the Commission’s *ex parte* rules.⁴²⁵ Persons making *ex parte* presentations must file a copy of any written presentation or a memorandum summarizing any oral presentation within two business days after the presentation (unless a different deadline applicable to the Sunshine period applies). Persons making oral *ex parte* presentations are reminded that memoranda summarizing the presentation must (1) list all persons attending or otherwise participating in the meeting at which the *ex parte* presentation was made, and (2) summarize all data presented and arguments made during the presentation. If the presentation consisted in whole or in part of the presentation of data or arguments already reflected in the presenter’s written comments, memoranda or other filings in the proceeding, the presenter may provide citations to such data or arguments in his or her prior comments, memoranda, or other filings (specifying the relevant page and/or paragraph numbers where such data or arguments can be found) in lieu of summarizing them in the memorandum. Documents shown or given to Commission staff during *ex parte* meetings are deemed to be written *ex parte* presentations and must be filed consistent with rule 1.1206(b). In proceedings governed by rule 1.49(f) or for which the Commission has made available a method of electronic filing, written *ex parte* presentations and memoranda summarizing oral *ex parte* presentations, and all attachments thereto, must be filed through the electronic comment filing system available for that proceeding, and must be filed in their native format (e.g., .doc, .xml, .ppt, searchable .pdf). Participants in this proceeding should familiarize themselves with the Commission’s *ex parte* rules.

163. *Comment Filing Procedures.* Pursuant to Sections 1.415 and 1.419, 47 CFR §§ 1.415, 1.419, interested parties may file comments and reply comments on or before the dates indicated on the first page of this document. Comments may be filed using the Commission’s Electronic Comment Filing System (ECFS). *See Electronic Filing of Documents in Rulemaking Proceedings*, 63 FR 24121 (1998).

- *Electronic Filers.* Comments may be filed electronically using the Internet by accessing the ECFS, <http://apps.fcc.gov/ecfs>.
- *Paper Filers.* Parties who file by paper must include an original and four copies of each filing. If more than one docket or rulemaking number appears in the caption of this proceeding, filers must submit two additional copies for each additional docket or rulemaking number.

Filings can be sent by hand or messenger delivery, by commercial overnight courier, or by first-class or overnight U.S. Postal Service mail. All filings must be addressed to the Commission’s Secretary, Office of the Secretary, Federal Communications Commission.

- All hand-delivered or messenger-delivered paper filings for the Commission’s Secretary must be delivered to FCC Headquarters at 445 12th Street, SW., Room TW-A325, Washington, DC 20554. The filing hours are 8:00 a.m. to 7:00 p.m. All hand deliveries must be held together with rubber bands or fasteners. Any envelopes must be disposed of *before* entering the building.
- Commercial overnight mail (other than U.S. Postal Service Express Mail and Priority Mail) must be sent to 9050 Junction Drive, Annapolis Junction, MD 20701.
- U.S. Postal Service first-class, Express, and Priority mail must be addressed to 445 12th Street, SW, Washington DC 20554.
- *Persons with Disabilities.* To request materials in accessible formats for persons with disabilities (braille, large print, electronic files, audio format), send an email to

⁴²⁵ 47 CFR §§ 1.1200 *et seq.*

fcc504@fcc.gov or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (TTY).

164. *Further Information.* For further information about this Notice, please contact 202-418-2470.

VIII. ORDERING CLAUSES

165. Accordingly, IT IS ORDERED, that pursuant to Sections 1, 4(i), 4(j), 301, 302, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 154(j), 301, 302a, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), 403; the National Environmental Policy Act of 1969, 42 U.S.C. § 4321 *et seq.*; and Section 704(b) of the Telecommunications Act of 1996, Pub. L. No. 104-104, this *Second Report and Order and Notice of Proposed Rulemaking* **IS HEREBY ADOPTED.**

166. IT IS FURTHER ORDERED that the Commission's rules **ARE AMENDED** as set forth in Appendix A. These rule revisions in this *Second Report and Order* will become effective **[60 days after date of publication Federal Register]**, except for Sections 2.1091 and 2.1093 of the rules, which contain information collection requirements subject to the Paperwork Reduction Act of 1995, Public Law 104-13, and will become effective after Office of Management and Budget (OMB) review and approval, on the effective date specified in a notice that the Commission will publish in the Federal Register announcing such approval and effective date.

167. IT IS FURTHER ORDERED that pursuant to Section 405 of the Communications Act of 1934, as amended, 47 U.S.C. § 405, and Section 1.429 of the Commission's rules, 47 CFR § 1.429, this *Memorandum Opinion and Order* **IS HEREBY ADOPTED** and the Petition for Reconsideration filed by AAJ **IS DISMISSED AND ALTERNATIVELY DENIED.**

168. IT IS FURTHER ORDERED that pursuant to authority contained in contained in Sections 4(i) and 4(j) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 154(j) and Section 1.430 of the Commission's rules, 47 CFR Section 1.430, the *Inquiry*, ET Docket No. 13-84 **IS TERMINATED.**

169. IT IS FURTHER ORDERED that pursuant to authority contained in contained in Sections 4(i) and 4(j) of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 154(j) and Section 1.430 of the Commission's rules, 47 CFR Section 1.430, ET Docket No. 03-137 **IS TERMINATED.**

170. IT IS FURTHER ORDERED, that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center **SHALL SEND** a copy of the *Second Report and Order*, including the Final Regulatory Flexibility Analysis, the Memorandum Opinion and Order, and the Notice of Proposed Rulemaking, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

Final Rules

The Federal Communications Commission amends title 47 of the Code of Federal Regulations, Parts 1, 2, 15, 18, 22, 24, 25, 27, 73, 90, 95, 97, and 101 as follows:

PART 1 – PRACTICE AND PROCEDURE

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

Authority: [INSERT CURRENT AUTHORITY CITATION].

2. Section 1.1307 is amended by revising paragraph (b) to read as follows:

§ 1.1307 Actions that may have a significant environmental effect, for which Environmental Assessments (EA) must be prepared.

* * * * *

(b)(1) With respect to the limits on human exposure to RF provided in Section 1.1310 of this chapter, applicants to the Commission for the grant or modification of construction permits, licenses or renewals thereof, temporary authorities, equipment authorizations, or any other authorizations for radiofrequency sources must either: (i) determine that they qualify for an exemption pursuant to Section 1.1307(b)(3); (ii) prepare an evaluation of the human exposure to RF radiation pursuant to Section 1.1310 and include in the application a statement confirming compliance with the limits in Section 1.1310; or (iii) prepare an Environmental Assessment if those RF sources would cause human exposure to levels of RF radiation in excess of the limits in Section 1.1310. Compliance with these limits for fixed RF source(s) may be accomplished by use of mitigation actions, as provided in Section 1.1307(b)(4). Upon request by the Commission, the party seeking or holding such authorization must submit technical information showing the basis for such compliance, either by exemption or evaluation. Notwithstanding the preceding requirements, in the event that RF sources cause human exposure to levels of RF radiation in excess of the limits in Section 1.1310 of this chapter, such RF exposure exemptions and evaluations are not deemed sufficient to show that there is no significant effect on the quality of the human environment or that the RF sources are categorically excluded from environmental processing.

- (2) *Definitions.* For the purposes of this Section, the following definitions shall apply.

Available maximum time-averaged power for an RF source is the maximum available RF power (into a matched load) as averaged over a *time-averaging period*;

Category One is any spatial region that is compliant with the general population exposure limit with *continuous exposure* or *source-based time-averaged exposure*;

Category Two is any spatial region where the general population exposure limit is exceeded but that is compliant with the occupational exposure limit with *continuous exposure*;

Category Three is any spatial region where the occupational exposure limit is exceeded but by no more than ten times the limit;

Category Four is any spatial region where the exposure is more than ten times the occupational exposure limit or where there is a possibility for serious injury on contact.

Continuous exposure refers to the maximum time-averaged exposure at a given location for an *RF source* and assumes that exposure may take place indefinitely. The exposure limits in Section 1.1310 of this chapter are used to establish the spatial regions where mitigation measures are necessary assuming continuous exposure as prescribed in Section 1.1307(b)(4) of this chapter.

Effective Radiated Power (ERP) is the product of the *maximum antenna gain* which is the largest far-field power gain relative to a dipole in any direction for each transverse polarization component, and the *maximum delivered time-averaged power* which is the largest net power delivered or supplied to an antenna as averaged over a *time-averaging period*; *ERP* is summed over two polarizations when present;

Exemption for (an) *RF source(s)* is solely from the obligation to perform a routine environmental evaluation to demonstrate compliance with the RF exposure limits in Section 1.1310 of this chapter; it is not exemption from the equipment authorization procedures described in Part 2 of this chapter, not exemption from general obligations of compliance with the RF exposure limits in Section 1.1310 of this chapter, and not exemption from determination of whether there is no significant effect on the quality of the human environment under Section 1.1306 of this chapter.

Fixed RF source is one that is physically secured at one location, even temporarily, and is not able to be easily moved to another location while radiating;

Mobile device is as defined in Section 2.1091(b) of this chapter;

Plane-wave equivalent power density is the square of the root-mean-square (rms) electric field strength divided by the impedance of free space (377 ohms).

Portable device is as defined in Section 2.1093(b) of this chapter;

Positive access control is mitigation by proactive preclusion of unauthorized access to the region surrounding an RF source where the continuous exposure limit for the general population is exceeded. Examples of such controls include locked doors, ladder cages, or effective fences, as well as enforced prohibition of public access to external surfaces of buildings. However, it does not include natural barriers or other access restrictions that did not require any action on the part of the licensee or property management.

Radiating structure is an unshielded RF current-carrying conductor that generates an RF reactive near electric or magnetic field and/or radiates an RF electromagnetic wave. It is the component of an *RF source* that transmits, generates, or reradiates an RF fields, such as an antenna, aperture, coil, or plate.

RF source is Commission-regulated equipment that transmits or generates RF fields or waves, whether intentionally or unintentionally, via one or more *radiating structure(s)*. Multiple *RF sources* may exist in a single *device*.

Separation distance (variable R in Table 1) is the minimum distance in any direction from any part of a *radiating structure* and any part of the body of a nearby person;

Source-based time averaging is an average of instantaneous exposure over a *time-averaging period* that is based on an inherent property or duty-cycle of a device to ensure compliance with the *continuous exposure* limits;

Time-averaging period is a time period not to exceed 30 minutes for fixed RF sources or a time period inherent from device transmission characteristics not to exceed 30 minutes for mobile and portable RF sources;

Transient individual is an untrained person in a location where occupational/controlled limits apply, and he or she must be made aware of the potential for exposure and be supervised by trained personnel pursuant to Section 1.1307(b)(4) of this chapter where use of time averaging is required to ensure compliance with the general population exposure limits in Section 1.1310 of this chapter.

(3) Determination of exemption.

(i) For single RF sources (*i.e.*, any single fixed RF source, mobile device, or portable device, as defined in Section 1.1307(b)(2) of this chapter): A single RF source is exempt if:

(A) the available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in Section 1.1307(b)(3)(ii)(A). Medical implant devices may only use this exemption and that in Section 1.1307(b)(3)(ii)(A);

(B) or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} (ERP_{20\text{ cm}}(d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20\text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20\text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

(C) or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1—Single RF Sources Subject to Routine Environmental Evaluation

RF Source Frequency (MHz)	Threshold ERP (watts)
0.3 – 1.34	1,920 R ²
1.34 – 30	3,450 R ² /f ²
30 – 300	3.83 R ²
300 – 1,500	0.0128 R ² f
1,500 – 100,000	19.2R ²

(ii) For multiple RF sources. Multiple RF sources are exempt if:

(A) the available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those in Section 1.1307(b)(3)(i)(A). Medical implant devices may only use this exemption and that in Section 1.1307(b)(3)(i)(A).

(B) in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

Where

- a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for P_{th} , including existing exempt transmitters and those being added.
- b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.
- c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.
- P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).
- $P_{th,i}$ = the exemption threshold power (P_{th}) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i .
- ERP_j = the ERP of fixed, mobile, or portable RF source j .
- $ERP_{th,j}$ = exemption threshold ERP for fixed, mobile, or portable RF source j , at a distance of at least $\lambda/2\pi$ according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

Evaluated_k = the maximum reported SAR or MPE of fixed, mobile, or portable RF source *k* either in the device or at the transmitter site from an existing evaluation at the location of exposure.

Exposure Limit_k = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source *k*, as applicable from Section 1.1310 of this chapter.

(4) Mitigation. (i) As provided in the following paragraphs, specific mitigation actions are required for fixed RF sources to the extent necessary to ensure compliance with our exposure limits, including the implementation of an RF safety plan, restriction of access to those RF sources, and disclosure of spatial regions where exposure limits are exceeded.

(ii) Category One – INFORMATION: No mitigation actions are required when the RF source does not cause continuous or source-based time-averaged exposure in excess of the general population limit in Section 1.1310 of this chapter. Optionally a green “INFORMATION” sign may offer information to those persons who might be approaching RF sources. This optional sign, when used, must include at least the following information: appropriate signal word “INFORMATION” and associated color (green), an explanation of the safety precautions to be observed when closer to the antenna than the information sign, a reminder to obey all postings and boundaries (if higher categories are nearby), up-to-date licensee (or operator) contact information (if higher categories are nearby), and a place to get additional information (such as a website, if no higher categories are nearby).

(iii) Category Two – NOTICE: Mitigation actions are required in the form of signs and positive access control surrounding the boundary where the continuous exposure limit is exceeded for the general population, with the appropriate signal word “NOTICE” and associated color (blue) on the signs. Signs must contain the components discussed in paragraph (b)(4)(vi) of this section. Under certain controlled conditions, such as on a rooftop with limited access, a sign attached directly to the surface of an antenna will be considered sufficient if the sign specifies a minimum approach distance and is readable at this separation distance and at locations required for compliance with the general population exposure limit in Section 1.1310 of this chapter. Appropriate training is required for any occupational personnel with access to controlled areas within restrictive barriers where the general population exposure limit is exceeded, and transient individuals must be supervised by trained occupational personnel upon entering any of these areas. Use of time averaging is required for transient individuals to ensure compliance with the general population exposure limit.

(iv) Category Three – CAUTION: Signs (with the appropriate signal word “CAUTION” and associated color (yellow) on the signs), controls, or indicators (*e.g.*, chains, railings, contrasting paint, diagrams) are required (in addition to the positive access control established for Category Two) surrounding the area in which the exposure limit for occupational personnel in a controlled environment is exceeded by no more than a factor of ten. Signs must contain the components discussed in paragraph (b)(4)(vi) of this section. If the boundaries between Category Two and Three are such that placement of both Category Two and Three signs would be in the same location, then the Category Two sign is optional. Under certain controlled conditions, such as on a rooftop with limited access, a sign may be attached directly to the surface of an antenna within a controlled environment if it specifies the minimum approach distance and is readable at this distance and at locations required for compliance with the occupational exposure limit in Section 1.1310 of this chapter. If signs are not used at the occupational exposure limit boundary, controls or indicators (*e.g.*, chains, railings, contrasting paint, diagrams, *etc.*) must designate the boundary where the occupational exposure limit is exceeded. Additionally, appropriate training is required for any occupational personnel with access to the controlled area where the general population exposure limit is exceeded, and transient individuals must be supervised by trained personnel upon entering any of these areas. Use of time averaging is required for transient individuals to ensure compliance with the general population exposure limit. Further mitigation by reducing exposure time in accord with six-minute time averaging is required for occupational personnel in the area in which

the occupational exposure limit is exceeded. However, proper use of RF personal protective equipment may be considered sufficient in lieu of time averaging for occupational personnel in the areas in which the occupational exposure limit is exceeded. If such procedures or power reduction, and therefore Category reduction, are not feasible, then lockout/tagout procedures in 29 CFR Section 1910.147 must be followed.

(v) Category Four – WARNING/DANGER: Where the occupational limit could be exceeded by a factor of more than ten, “WARNING” signs with the associated color (orange), controls, or indicators (e.g., chains, railings, contrasting paint, diagrams) are required (in addition to the positive access control established for Category Two) surrounding the area in which the occupational exposure limit in a controlled environment is exceeded by more than a factor of ten. Signs must contain the components discussed in paragraph (b)(4)(vi) of this section. “DANGER” signs with the associated color (red) are required where immediate and serious injury will occur on contact, in addition to positive access control, regardless of mitigation actions taken in Categories Two or Three. If the boundaries between Category Three and Four are such that placement of both Category Three and Four signs would be in the same location, then the Category Three sign is optional. No access is permitted without Category reduction. If power reduction, and therefore Category reduction, is not feasible, then lockout/tagout procedures in 29 CFR Section 1910.147 must be followed.

(vi) RF exposure advisory signs must be viewable and readable from the boundary where the applicable exposure limits are exceeded, pursuant to 29 CFR Section 1910.145, and include at least the following five components:

(A) Appropriate signal word, associated color {i.e., “DANGER” (red), “WARNING” (orange), “CAUTION,” (yellow) “NOTICE” (blue)};

(B) RF energy advisory symbol);

(C) An explanation of the RF source;

(D) Behavior necessary to comply with the exposure limits; and

(E) Up-to-date contact information.

(5)(i) In general, when the exposure limits specified in Section 1.1310 are exceeded in an accessible area due to the emissions from multiple fixed RF sources, actions necessary to bring the area into compliance or preparation of an Environmental Assessment (EA) as specified in Section 1.1311 are the shared responsibility of all licensees whose RF sources produce, at the area in question, levels that exceed 5% of the applicable exposure limit proportional to power. However, a licensee demonstrating that its facility was not the most recently modified or newly-constructed facility at the site establishes a rebuttable presumption that such licensee should not be liable in an enforcement proceeding relating to the period of non-compliance. Field strengths must be squared to be proportional to SAR or power density. Specifically, these compliance requirements apply if the square of the electric or magnetic field strength exposure level applicable to a particular RF source exceeds 5% of the square of the electric or magnetic field strength limit at the area in question where the levels due to multiple fixed RF sources exceed the exposure limit. Site owners and managers are expected to allow applicants and licensees to take reasonable steps to comply with the requirements contained in Section 1.1307(b)(1) and, where feasible, should encourage co-location of RF sources and common solutions for controlling access to areas where the RF exposure limits contained in Section 1.1310 might be exceeded. Applicants and licensees are required to share technical information necessary to ensure joint compliance with the exposure limits, including informing other licensees at a site in question of evaluations indicating possible non-compliance with the exposure limits.

(ii) Applicants for proposed RF sources that would cause non-compliance with the limits specified in Section 1.1310 at an accessible area previously in compliance must submit an EA if emissions from the applicant's RF source would produce, at the area in question, levels that exceed 5% of the applicable exposure limit. Field strengths must be squared if necessary to be proportional to SAR or power density.

(iii) Renewal applicants whose RF sources would cause non-compliance with the limits specified in Section 1.1310 at an accessible area previously in compliance must submit an EA if emissions from the applicant's RF source would produce, at the area in question, levels that exceed 5% of the applicable exposure limit. Field strengths must be squared if necessary to be proportional to SAR or power density.

* * * * *

3. Section 1.1310 is revised to read as follows:

§ 1.1310 Radiofrequency radiation exposure limits.

(a) Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b) within the frequency range of 100 kHz to 6 GHz (inclusive).

(b) The SAR limits for occupational/controlled exposure are 0.4 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 8 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit for occupational/controlled exposure is 20 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 6 minutes to determine compliance with occupational/controlled SAR limits.

(c) The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

(d)(1) Evaluation with respect to the SAR limits in this section must demonstrate compliance with both the whole-body and peak spatial-average limits using technically supported measurement or computational methods and exposure conditions in advance of authorization (licensing or equipment certification) and in a manner that facilitates independent assessment and, if appropriate, enforcement. Numerical computation of SAR must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by FCC-accepted numerical computation standards or available FCC procedures for the specific computational method.

(2) For operations within the frequency range of 300 kHz and 6 GHz (inclusive), the limits for maximum permissible exposure (MPE), derived from whole-body SAR limits and listed in Table 1 of paragraph (e)(1) of this section, may be used instead of whole-body SAR limits as set forth in paragraph (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in Section 1.1307(b), except for portable devices as defined in Section 2.1093 as these evaluations shall be performed according to the SAR provisions in Section 2.1093 of this chapter.

(3) At operating frequencies above 6 GHz, the MPE limits listed in Table 1 of paragraph (e)(1) of this section shall be used in all cases to evaluate the environmental impact of human exposure to RF radiation as specified in Section 1.1307(b).

(4) Both the MPE limits listed in Table 1 of paragraph (e)(1) of this section and the SAR limits as set forth in paragraph (a) through (c) of this section are for continuous exposure, that is, for indefinite time periods. Exposure levels higher than the limits are permitted for shorter exposure times, as long as the average exposure over a period not more than the specified averaging time in Table 1 is less than (or equal to) the exposure limits. Detailed information on our policies regarding procedures for evaluating compliance with all of these exposure limits can be found in the most recent edition of FCC's *OET Bulletin 65*, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," and its supplements, all available at the FCC's Internet Web site: <https://www.fcc.gov/general/oet-bulletins-line>, and in the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) (<https://www.fcc.gov/kdb>).

Note to Paragraphs (a) through (d): SAR is a measure of the rate of energy absorption due to exposure to RF electromagnetic energy. These SAR limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized SAR in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5, copyright 1986 by NCRP, Bethesda, Maryland 20814. Limits for whole body SAR and peak spatial-average SAR are based on recommendations made in both of these documents. The MPE limits in Table 1 are based generally on criteria published by the NCRP in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2 and 17.4.3, copyright 1986 by NCRP, Bethesda, Maryland 20814. In the frequency range from 100 MHz to 1500 MHz, these MPE exposure limits for field strength and power density are also generally based on criteria recommended by the ANSI in Section 4.1 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.

(e)(1) Table 1 sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	*(100)	≤ 6
3.0–30	1842/f	4.89/f	*(900/f ²)	< 6
30–300	61.4	0.163	1.0	< 6
300–1500			f/300	< 6
1500–100,000			5	< 6

(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	< 30
1.34–30	824/f	2.19/f	*(180/f ²)	< 30
30–300	27.5	0.073	0.2	< 30
300–1500			f/1500	< 30
1500–100,000			1.0	< 30

f = frequency in MHz

* = Plane-wave equivalent power density

(2) Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. The phrase *fully aware* in the context of applying these exposure limits means that an exposed person has received written and/or verbal information fully explaining the potential for RF exposure resulting from his or her employment. With the exception of *transient* persons, this phrase also means that an exposed person has received appropriate training regarding work practices relating to controlling or mitigating his or her exposure. In situations when an untrained person is transient through a location where occupational/controlled limits apply, he or she must be made aware of the potential for exposure and be supervised by trained personnel pursuant to Section 1.1307(b)(2) of this chapter where use of time averaging is required to ensure compliance with the general population exposure limit. The phrase *exercise control* means that an exposed person is allowed and also knows how to reduce or avoid exposure by administrative or engineering work practices, such as use of personal protective equipment or time averaging of exposure.

(3) General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure. For example, RF sources intended for consumer use shall be subject to the limits for general population/uncontrolled exposure in this section.

* * * * *

§ 1.4000 [Amended]

4. In Section 1.4000, remove and reserve paragraph (c).

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

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

Authority: [INSERT CURRENT AUTHORITY CITATION].

6. Section 2.1033 is amended by adding paragraph (f) to read as follows:

* * * * *

(f) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of RF sources under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

7. Section 2.1091 is amended by revising paragraphs (b), (c), (d)(1), and (d)(2) to read as follows:

§ 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.

* * * * *

(b) For purposes of this Section, the definitions in Section 1.1307(b)(2) of this chapter shall apply. A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the RF source's radiating structure(s) and the body of the user or nearby persons. In this context, the term “fixed location” means that the device is physically secured at one location and is not able to be easily moved to another location while transmitting. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal desktop computer, are considered to be mobile devices if they meet the 20-centimeter separation requirement.

(c)(1) Evaluation of compliance with the exposure limits in Section 1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for mobile devices with single RF sources having either more than an available maximum time-averaged power of 1 mW or more than the ERP listed in Table 1 of Section 1.1307(b)(3)(i)(C), whichever is greater. For mobile devices not exempt by Section 1.1307(b)(3)(i)(C) at distances from 20 centimeters to 40 centimeters and frequencies from 0.3 GHz to 6 GHz, evaluation of compliance with the exposure limits in Section 1.1310 of this chapter is necessary if the ERP of the device is greater than ERP_{20cm} in the formula below. If the ERP of a single RF source at distances from 20 centimeters to 40 centimeters and frequencies from 0.3 GHz to 6 GHz is not easily obtained, then the available maximum time-averaged power may be used (*i.e.*, without consideration of ERP) in comparison with the following formula only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

$$P_{\text{eff}}(\text{mW}) = ERP_{20\text{cm}}(\text{mW}) = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

(2) For multiple mobile or portable RF sources within a device operating in the same time averaging period, routine environmental evaluation is required if the formula in Section 1.1307(b)(3)(ii)(B) of this chapter is applied to determine the exemption ratio and the result is greater than 1.

(3) Unless otherwise specified in this chapter, any other single mobile or multiple mobile and portable RF source(s) associated with a device is exempt from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in Sections 1.1307(c) and 1.1307(d) of this chapter.

(d)(1) Applications for equipment authorization of mobile RF sources subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in Section 1.1310 of this chapter as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request. In general, maximum time-averaged power levels must be used for evaluation. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

(2)(i) For purposes of analyzing mobile transmitting devices under the occupational/controlled criteria specified in Section 1.1310 of this chapter, time averaging provisions of the limits may be used in conjunction with the maximum duty factor to determine maximum time-averaged exposure levels under normal operating conditions.

(ii) Such time averaging provisions based on maximum duty factor may not be used in determining exposure levels for devices intended for use by consumers in general population/uncontrolled environments as defined in Section 1.1310 of this chapter. However, “source-based” time averaging based on an inherent property of the RF source is allowed over a time period not to exceed 30 minutes. An example of this is the determination of exposure from a device that uses digital technology such as a time-division multiple-access (TDMA) scheme for transmission of a signal.

* * * * *

8. Section 2.1093 is amended by revising paragraphs (b), (c), and (d) to read as follows:

§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices.

* * * * *

(b) For purposes of this section, the definitions in Section 1.1307(b)(2) of this chapter shall apply. A portable device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that the RF source's radiating structure(s) is/are within 20 centimeters of the body of the user.

(c)(1) Evaluation of compliance with the exposure limits in Section 1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for portable devices having single RF sources with more than an available maximum time-averaged power of 1 mW, more than the ERP listed in Table 1 of Section 1.1307(b)(3)(i)(C), or more than the P_{th} in the following formula, whichever is greater. The following formula shall only be used in conjunction with portable devices not exempt by Section 1.1307(b)(3)(i)(C) at distances from 0.5 centimeters to 20 centimeters and frequencies from 0.3 GHz to 6 GHz.

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20cm} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20cm} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

$$ERP_{20cm} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the minimum separation distance (cm) in any direction from any part of the device antenna(s) or radiating structure(s) to the body of the device user.

(2) For multiple mobile or portable RF sources within a device operating in the same time averaging period, evaluation is required if the formula in Section 1.1307(b)(3)(ii)(B) of this chapter is applied to determine the exemption ratio and the result is greater than 1.

(3) Unless otherwise specified in this chapter, any other single portable or multiple mobile and portable RF source(s) associated with a device is exempt from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in Sections 1.1307(c) and 1.1307(d) of this chapter.

(d)(1) Applications for equipment authorization of portable RF sources subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in Section 1.1310 of this chapter as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request. The SAR limits specified in Sections 1.1310(a) through (c) of this chapter shall be used for evaluation of portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz shall be evaluated in terms of the MPE limits specified in Table 1 of Section 1.1310(e)(1) of this chapter. A minimum separation distance applicable to the operating configurations and exposure conditions of the device shall be used for the evaluation. In general, maximum time-averaged power levels must be used for evaluation. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

(2) Evaluation of compliance with the SAR limits can be demonstrated by either laboratory measurement techniques or by computational modeling. The latter must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by FCC-accepted numerical computation standards or available FCC procedures for the specific computational method. Guidance regarding SAR measurement techniques can be found in the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB). The staff guidance provided in the KDB does not necessarily represent the only acceptable methods for measuring RF exposure or RF emissions, and is not binding on the Commission or any interested party.

(3) For purposes of analyzing portable RF sources under the occupational/controlled SAR criteria specified in Section 1.1310 of this chapter, time averaging provisions of the limits may be used in conjunction with the maximum duty factor to determine maximum time-averaged exposure levels under normal operating conditions.

(4) The time averaging provisions for occupational/controlled SAR criteria, based on maximum duty factor, may not be used in determining typical exposure levels for portable devices intended for use by consumers, such as cellular telephones, that are considered to operate in general population/uncontrolled environments as defined in Section 1.1310 of this chapter. However, “source-based” time averaging based on an inherent property of the RF source is allowed over a time period not to exceed 30 minutes. An example of this would be the determination of exposure from a device that uses digital technology such as a time-division multiple-access (TDMA) scheme for transmission of a signal.

(5) Visual advisories (such as labeling, embossing, or on an equivalent electronic display) on portable devices designed only for occupational use can be used as part of an applicant’s evidence of the device user’s awareness of occupational/controlled exposure limits. Such visual advisories shall be legible and clearly visible to the user from the exterior of the device. Visual advisories must indicate that the device is for occupational use only, refer the user to specific information on RF exposure, such as that provided in a user manual and note that the advisory and its information is required for FCC RF exposure compliance. Such instructional material must provide users with information on how to use the device and to ensure users are *fully aware* of and able to *exercise control* over their exposure to satisfy compliance with the occupational/controlled exposure limits. A sample of the visual advisory, illustrating its location on the device, and any instructional material intended to accompany the device when marketed, shall be filed with the Commission along with the application for equipment authorization. Details of any special training requirements pertinent to mitigating and limiting RF exposure should also

be submitted. Holders of grants for portable devices to be used in occupational settings are encouraged, but not required, to coordinate with end-user organizations to ensure appropriate RF safety training.

(6) General population/uncontrolled exposure limits defined in Section 1.1310 of this chapter apply to portable devices intended for use by consumers or persons who are exposed as a consequence of their employment and may not be fully aware of the potential for exposure or cannot exercise control over their exposure. No communication with the consumer including either visual advisories or manual instructions will be considered sufficient to allow consumer portable devices to be evaluated subject to limits for occupational/controlled exposure specified in Section 1.1310 of this chapter.

PART 15 – RADIO FREQUENCY DEVICES

9. The authority citation for part 15 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

10. Section 15.212 is amended by revising paragraph (a)(viii) to read as follows:

§ 15.212 Modular transmitters.

(a) * * *

(viii) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of modular transmitters under this section must contain a statement confirming compliance with these requirements. The modular transmitter must comply with any applicable RF exposure requirements in its final configuration. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

11. Section 15.247 is amended by revising paragraph (i) to read as follows:

§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

* * * * *

(i) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

12. Section 15.255 is amended by revising paragraph (g) to read as follows:

§ 15.255 Operation within the band 57-71 GHz.

* * * * *

(g) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

13. Section 15.257 is amended by revising paragraph (g) to read as follows:

§ 15.257 Operation within the band 92-95 GHz.

* * * * *

(g) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

14. Section 15.319 is amended by revising paragraph (i) to read as follows:

§ 15.319 General technical requirements.

* * * * *

(i) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a “general population/uncontrolled” environment. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

15. Section 15.407 is amended by revising paragraph (f) to read as follows:

§ 15.407 General technical requirements.

* * * * *

(f) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a “general population/uncontrolled” environment. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

16. Section 15.709 is amended by revising paragraph (h) to read as follows:

§ 15.709 General technical requirements.

* * * * *

(h) *Compliance with radio frequency exposure requirements.* White space devices shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of RF sources under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 18 - INDUSTRIAL, SCIENTIFIC AND MEDICAL EQUIPMENT

17. The authority citation for part 18 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

18. Section 18.313 is added to read as follows:

§ 18.313 Radio frequency exposure requirements.

Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate.

PART 22 – PUBLIC MOBILE SERVICES

19. The authority citation for part 22 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

20. Section 22.379 is added to read as follows:

§ 22.379 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 24 – PERSONAL COMMUNICATIONS SERVICES

21. The authority citation for part 24 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

§ 24.51 [Amended]

22. In Section 24.51, remove and reserve paragraph (c).
23. Section 24.52 is revised to read as follows:

§ 24.52 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 25 – SATELLITE COMMUNICATIONS

24. The authority citation for part 25 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

25. Section 25.115 is amended by reserving paragraphs (l) through (o) and by adding a new paragraph (p) to read as follows:

§ 25.115 Application for earth station authorizations.

* * * * *

(p) The licensee and grantees shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter. See Section 1.1307(b)(5)(ii).

26. Section 25.117 is amended by revising paragraph (g) to read as follows:

§ 25.117 Modification of station license.

* * * * *

(g) The licensee and grantees shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter. See Section 1.1307(b)(5)(iii).

27. Section 25.129 is amended by revising paragraph (c) to read as follows:

§ 25.129 Equipment authorization for portable earth-station transceivers.

* * * * *

(c) In addition to the information required by Section 2.1033(c) of this chapter, applicants for certification required by this section shall submit any additional equipment test data necessary to demonstrate compliance with pertinent standards for transmitter performance prescribed in Sections 25.138, 25.202(f), 25.204, 25.209, and 25.216, must demonstrate compliance with the labeling requirement in Section 25.285(b), and shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in

combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

28. Section 25.149 is amended by revising paragraph (c)(3) to read as follows:

§ 25.149 Application requirements for ancillary terrestrial components in Mobile-Satellite Service networks operating in the 1.5./1.6 GHz and 1.6/2.4 GHz Mobile-Satellite Service.

* * * * *

(c) * * *

(3) Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

29. Section 25.271 is amended by revising paragraph (g) to read as follows:

§ 25.271 Control of transmitting stations.

* * * * *

(g) All applicants shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applicants with terminals that will exceed the guidelines in Section 1.1310 of this chapter for radio frequency radiation exposure shall provide a plan for mitigation of radiation exposure to the extent required to meet those guidelines. Licensees of transmitting earth stations are prohibited from using remote earth stations in their networks that are not designed to stop transmission when synchronization to signals from the target satellite fails.

* * * * *

PART 27 – MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES

30. The authority citation for part 27 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

31. Section 27.52 is revised to read as follows:

§ 27.52 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

PART 73 – RADIO BROADCAST SERVICES

32. The authority citation for part 73 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

33. Section 73.404 is amended by revising paragraph (e)(10) to read as follows:

§73.404 Interim hybrid IBOC DAB operation.

* * * * *

(e) * * *

(10) Licensees and permittees shall ensure compliance with the Commission's radio frequency exposure requirements in Section 1.1307(b) of this chapter. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter.

PART 90 – PRIVATE LAND MOBILE RADIO SERVICES

34. The authority citation for part 90 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

35. Section 90.223 is added to read as follows:

§ 90.223 RF exposure.

Licensees and manufacturers shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

§ 90.1217 [Removed]

36. Section 90.1217 is removed.

PART 95 – PERSONAL RADIO SERVICES

37. The authority citation for part 95 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

38. Section 95.1125 is revised to read as follows:

§ 95.2385 WMTS RF exposure evaluation.

Mobile and portable devices as defined in Sections 2.1091(b) and 2.1093(b) of this chapter operating in the WMTS are subject to radio frequency radiation exposure requirements as specified in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of WMTS devices must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

39. Section 95.2585 is revised to read as follows:

§ 95.2585 MedRadio RF exposure evaluation.

A MedRadio medical implant device or medical body-worn transmitter is subject to the radiofrequency radiation exposure requirements specified in Sections 1.1307(b) and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must demonstrate compliance with these requirements using either computational modeling or laboratory measurement techniques. Where a showing is based on computational modeling, the Commission retains the discretion to request that supporting documentation and/or specific absorption rate (SAR) measurement data be submitted, as described in Section 2.1093(d)(1) of this chapter.

PART 97 – AMATEUR RADIO SERVICE

40. The authority citation for part 97 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

41. Section 97.13 is amended by revising paragraph (c)(1) to read as follows:

§ 97.13 Restrictions on station location.

* * * * *

(c) * * *

(1) The licensee shall ensure compliance with the Commission's radio frequency exposure requirements in Sections 1.1307(b), 2.1091, and 2.1093 of this chapter, where applicable. In lieu of evaluation with the general population/uncontrolled exposure limits, amateur licensees may evaluate their operation with respect to members of his or her immediate household using the occupational/controlled exposure limits in Section 1.1310, provided appropriate training and information has been accessed by the amateur licensee and members of his/her household. RF exposure of other nearby persons who are not members of the amateur licensee's household must be evaluated with respect to the general population/uncontrolled exposure limits. Appropriate methodologies and guidance for evaluating amateur radio service operation is described in the Office of Engineering and Technology (OET) Bulletin 65, Supplement B.

* * * * *

PART 101 – FIXED MICROWAVE SERVICE

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

Authority: [INSERT CURRENT AUTHORITY CITATION].

43. Section 101.1425 is revised to read as follows:

§ 101.1425 RF exposure.

MVDDS stations in the 12.2–12.7 GHz frequency band shall ensure compliance with the Commission's radio frequency exposure requirements in Section 1.1307(b) of this chapter. An Environmental Assessment may be required if RF radiation from the proposed facilities would, in combination with radiation from other sources, cause RF power density or field strength in an accessible area to exceed the applicable limits specified in Section 1.1310 of this chapter.

APPENDIX B

Proposed Rules

For the reasons set forth above, Parts 1, 2, and 18 of title 47 of the Code of Federal Regulations are proposed to be amended as follows:

PART 1 – PRACTICE AND PROCEDURE

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

Authority: [INSERT CURRENT AUTHORITY CITATION].

2. Section 1.1307 is amended by adding a definition to paragraph (b) to read as follows:

§ 1.1307 Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.

* * * * *

(b) * * *

Device-based time averaging is where the instantaneous transmit power and duration of each transmission burst is managed by the device over some specified *time-averaging period* to ensure compliance with the RF exposure limits.

* * * * *

3. Section 1.1310 is amended to read as follows:

§ 1.1310 Radiofrequency radiation exposure limits.

(a) Between 3 kHz and 10 MHz (inclusive), internal electric field limits as set forth in paragraph (f) of this section shall be used to evaluate the environmental impact of human exposure to RF radiation as specified in Section 1.1307(b). Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b) within the frequency range of 100 kHz to 6 GHz (inclusive). Power density (PD) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b) for the frequency range above 6 GHz.

(b) The SAR limits for occupational/controlled exposure are 0.4 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 8 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit for occupational/controlled exposure is 20 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). The PD limits for occupational/controlled exposure are 5 mW/cm², as averaged over the whole body, and a peak spatial-average PD of 20 mW/cm², averaged over any 1 cm². Exposure may be averaged over a time period not to exceed 6 minutes to determine compliance with occupational/controlled SAR limits.

(c) The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). The PD limits

for general population/uncontrolled exposure are 1 mW/cm^2 , as averaged over the whole body, and a peak spatial-average PD of 4 mW/cm^2 , averaged over any 1 cm^2 . Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

(d)(1) Evaluation with respect to the SAR and/or PD limits in this section must demonstrate compliance with both the whole-body and peak spatial-average limits. Evaluation with respect to both the SAR and PD limits in this section and in Section 2.1093 of this chapter, as well as the internal electric field limits in this section where applicable, shall be done using technically supported measurement or computational methods and exposure conditions in advance of authorization (licensing or equipment certification) and in a manner that facilitates independent assessment and, if appropriate, enforcement. Numerical computation of SAR must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by FCC-accepted numerical computation standards or available FCC procedures for the specific computational method.

(2) The limits for maximum permissible exposure (MPE) listed in Table 1 of paragraph (e) of this section, which have been derived from whole-body SAR limits, may be used instead of whole-body SAR and/or PD limits as set forth in paragraphs (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in Section 1.1307(b), except for portable devices as defined in Section 2.1093 as these evaluations shall be performed according to the SAR and/or PD provisions, and internal electric field provisions where applicable, in Section 2.1093 of this chapter.

(3) The MPE limits listed in Table 1 of paragraph (e) of this section, the SAR and/or PD limits as set forth in paragraph (a) through (c) of this section and in Section 2.1093 of this chapter, and the internal electric field limits listed in Table 2 of paragraph (f) of this section are for continuous exposure, that is, for indefinite time periods. Except for internal electric field, as described in (f) of this section, exposure levels higher than the limits are permitted for shorter exposure times, as long as the average exposure over a period not to exceed the specified averaging time in Table 1 or source-based time averaging requirement of Sections 2.1091(d)(2) and 2.1093(d)(5) for general population exposure is less than the limits. Detailed information on our policies regarding procedures for evaluating compliance with all of these exposure limits can be found in the FCC's *OET Bulletin 65*, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," and in supplements to *Bulletin 65*, all available at the FCC's Internet Web site: <http://www.fcc.gov/rfsafety> and in the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB) (<https://www.fcc.gov/kdb>).

Note to Paragraphs (a) through (d): SAR is a measure of the rate of energy absorption due to exposure to RF electromagnetic energy. These SAR limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized SAR in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5, copyright 1986 by NCRP, Bethesda, Maryland 20814. Limits for whole body SAR and peak spatial-average SAR are based on recommendations made in both of these documents. Internal electric field limits in Table 2 of paragraph (f) of this section are generally based on guidelines recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) in "ICNIRP Guidelines for Limiting Human Exposure to Time-Varying Electric and Magnetic Fields (1 Hz to 100 kHz)," Published in Volume 99, Issue 6, Pages 818-836, copyright 2010 by the Health Physics Society and available at <http://www.icnirp.org>. The MPE limits in Table 1 are based generally on criteria published by the NCRP in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2 and 17.4.3, copyright 1986 by NCRP, Bethesda, Maryland 20814. In the frequency range from 100 MHz to 1500 MHz, these MPE exposure limits for field strength and power

density are also generally based on criteria recommended by the ANSI in Section 4.1 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. Peak spatial-average PD limits of 4 mW/cm² for general population/uncontrolled exposure and 20 mW/cm² for occupational/controlled exposure in the frequency range from 6 GHz to 300 GHz are generally based on criteria recommended at 6 GHz by the ANSI in Section 4.4 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” ANSI/IEEE Std C95.1-1992, copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017, and on thermal perception thresholds at frequencies above 6 GHz.

(e)(1) Table 1 sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

Table 1—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-3,000,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-3,000,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density, electric and magnetic field strengths are root-mean-square (rms)

(2) * * *

(3) * * *

(3) * * *

(4) * * *

(f) Internal electric field shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b) within the frequency range of 3 kHz to 10 MHz (inclusive). Internal electric fields shall be determined as a vector average in a contiguous tissue volume of 2 × 2 × 2 cubic millimeters. Internal electric fields induced by electric or magnetic fields including transient or very short-term peak fields shall be regarded as instantaneous values not to be time-averaged.

Table 2—Limits for Internal Electric Field

Frequency range (MHz)	Internal electric field strength (rms) (V/m)
(A) Limits for Occupational/Controlled Exposure	
0.003-10	270f
(B) Limits for General Population/Uncontrolled Exposure	
0.003-10	135f

f = frequency in MHz

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

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

Authority: [INSERT CURRENT AUTHORITY CITATION].

5. Section 2.1091 is amended by revising paragraph (d) to read as follows:

§ 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.

* * * * *

(d)(1) Applications for equipment authorization of mobile RF sources subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in Section 1.1310 of this chapter as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request. In general, maximum time-averaged power levels must be used for evaluation. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

(2) For purposes of analyzing mobile transmitting devices under the occupational/controlled criteria specified in Section 1.1310 of this chapter, time averaging provisions of the limits may be used in conjunction with maximum duty factor to determine maximum time-averaged exposure levels under normal operating conditions.

(3) Such time averaging provisions based on maximum duty factor may not be used in determining exposure levels for devices intended for use by consumers in general population/uncontrolled environments as defined in Section 1.1310 of this chapter. However, either “source-based” time averaging, based on an inherent property of the RF source, or “device-based” time averaging based on an inherent capability of the device in direct control of the RF source, is allowed.

(4) * * *

(5) * * *

* * * * *

6. Section 2.1093 is amended by revising paragraph (d) to read as follows:

§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices.

* * * * *

(d)(1) Applications for equipment authorization of portable RF sources subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in Section 1.1310 of this chapter as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request. In general, maximum time-averaged power levels must be used for evaluation. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

(2) Evaluation of compliance with the SAR limits can be demonstrated by either laboratory measurement techniques or by computational modeling. The latter must be supported by adequate documentation showing that the numerical method as implemented in the computational software has been fully validated; in addition, the equipment under test and exposure conditions must be modeled according to protocols established by FCC-accepted numerical computation standards or available FCC procedures for the specific computational method. Guidance regarding SAR, PD, internal electric field, and MPE measurement techniques, where applicable, can be found in the Office of Engineering and Technology (OET) Laboratory Division Knowledge Database (KDB). The staff guidance provided in the KDB does not necessarily represent the only acceptable methods for measuring RF exposure or RF emissions, and is not binding on the Commission or any interested party.

(3) For purposes of analyzing portable RF sources under the occupational/controlled SAR criteria specified in Section 1.1310 of this chapter, the time averaging provisions of these SAR criteria may be used to determine maximum time-averaged exposure levels under normal operating conditions.

(4) The time averaging provisions for occupational/controlled SAR/PD criteria, based on maximum duty factor, may not be used in determining typical exposure levels for portable devices intended for use by consumers, such as cellular telephones, that are considered to operate in general population/uncontrolled environments as defined in Section 1.1310 of this chapter. However, either “source-based” time averaging, based on an inherent property of the RF source, or “device-based” time averaging based on an inherent capability of the device in direct control of the RF source, is allowed, as described in paragraph (d)(6) of this section.

(5) Visual advisories (such as labeling, embossing, or on an equivalent electronic display) on portable devices designed only for occupational use can be used as part of an applicant’s evidence of the device user’s awareness of occupational/controlled exposure limits. Such visual advisories shall be legible and clearly visible to the user from the exterior of the device. Visual advisories must indicate that the device is for occupational use only, refer the user to specific information on RF exposure, such as that provided in a user manual and note that the advisory and its information is required for FCC RF exposure compliance. Such instructional material must provide the user with information on how to use the device in order to ensure compliance with the occupational/controlled exposure limits. A sample of the visual advisory, illustrating its location on the device, and any instructional material intended to accompany the device when marketed, shall be filed with the Commission along with the application for equipment authorization. Details of any special training requirements pertinent to limiting RF exposure should also be submitted. Holders of grants for portable devices to be used in occupational settings are encouraged, but not required, to coordinate with end-user organizations to ensure appropriate RF safety training.

(6) General population/uncontrolled exposure limits defined in Section 1.1310 of this chapter apply to portable devices intended for use by consumers or persons who are exposed as a consequence of their employment and may not be fully aware of the potential for exposure or cannot exercise control over their exposure. No communication with the consumer including either visual advisories or manual instructions will be considered sufficient to allow consumer portable devices to be evaluated subject to limits for occupational/controlled exposure specified in Section 1.1310 of this chapter.

(7) “Device-based” time averaging, based on an inherent capability of the device in direct control of the RF source(s) within a device, is permitted if the protocols established to track the instantaneous

transmit power over a time averaging period not to exceed the values listed in Table 1 for the specific operating frequencies of each transmitter have been validated against available FCC procedures for the “device-based” time averaging method to be used by the device.

Table 1 –Maximum Averaging Times for Device-Based Time Averaging

Frequency (GHz):	< 2.9	2.9-7.125	7.125-10.5	10.5-15.4	15.4-24	24-37	37-53	53-95	> 95
Time (seconds):	100	49	27	14	7	4	3	2	1

* * * * *

PART 18 – INDUSTRIAL, SCIENTIFIC, AND MEDICAL EQUIPMENT

7. The authority citation for part 18 continues to read as follows:

Authority: [INSERT CURRENT AUTHORITY CITATION].

8. Section 18.107 is amended by adding paragraph (k) to read as follows:

§ 18.107 Definitions.

* * * * *

(k) Wireless power transfer (WPT) equipment. A category of ISM equipment which generates and emits RF energy for local use by inductive, capacitive or radiative coupling, for transfer of electromagnetic energy between a power transfer unit (TU) and receiving unit(s) (RU) of a WPT system.

* * * * *

9. Section 18.123 is added to read as follows:

§ 18.123 Transition Provisions for Wireless Power Transfer Equipment.

All wireless power transfer equipment that are manufactured, imported, marketed or installed on or after [6 months after the effective date of final rules] shall comply with all the provisions for wireless power transfer devices of this part.

* * * * *

10. Section 18.203 is amended by adding paragraph (d) to read as follows:

§ 18.203 Equipment authorization.

* * * * *

(d) Wireless power transfer equipment shall be authorized under the Certification procedure prior to use or marketing, in accordance with the relevant sections of part 2, subpart J of this chapter.

* * * * *

11. Section 18.207 is amended by adding new paragraph (e)(6) to read as follows:

§ 18.207 Technical report.

* * * * *

(e) * * *

(6) For wireless power transfer equipment, a statement confirming compliance for radio frequency radiation exposure in accordance with the requirements in 47 CFR. Sections 1.1307(b), 1.1310, 2.1091, and 2.1093, as appropriate. Applications for equipment authorization of RF sources operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

APPENDIX C

Initial Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980 (RFA),¹ the Commission has prepared this Initial Regulatory Flexibility Analysis (IRFA) of the possible significant economic impact on a substantial number of small entities by the policies and rules proposed in this *Notice of Proposed Rulemaking (Notice)*.

Written public comments are requested on this IRFA. Comments must be identified as responses to the IRFA and must be filed by the deadlines for comments provided in this *Notice*. The Commission will send a copy of the *Notice*, including this IRFA, to the Chief Counsel for Advocacy of the Small Business Administration (SBA).² In addition, the *Notice* and IRFA (or summaries thereof) will be published in the Federal Register.³

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

The National Environmental Policy Act of 1969 (NEPA) requires agencies of the Federal Government to evaluate the effects of their actions on the quality of the human environment.⁴ To meet its responsibilities under NEPA, the Commission has adopted requirements for evaluating the environmental impact of its actions.⁵ One of several environmental factors addressed by these requirements is human exposure to radiofrequency (RF) energy emitted by FCC-regulated transmitters, facilities, and devices.⁶

The *Notice* proposes to amend Parts 1, 2, and 18 of our rules relating to the compliance of FCC-regulated transmitters, facilities, and devices with the guidelines for human exposure to radiofrequency (RF) energy. Specifically, we are proposing to make certain revisions in our rules that we believe will result in more efficient, practical and consistent application of compliance procedures. The *Notice* seeks to develop a record that will enable the Commission to meet the challenges presented by evolving technological advances not resolved in the previous RF exposure proceedings. The *Notice* seeks comment on expanding the range of frequencies for which the RF exposure limits apply; on applying localized exposure limits above 6 GHz in parallel to the localized exposure limits already established below 6 GHz; on specifying the conditions under which and the methods by which the limits are averaged, in both time and area, during evaluation for compliance with the rules; and on addressing new issues raised by Wireless Power Transfer devices.

B. Legal Basis

The proposed action is authorized under Sections 1, 4(i), 4(j), 301, 203, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), and 403 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 154(i), 154(j), 301, 302a, 303(r), 307, 308, 309, 332(a)(1), 332(c)(7)(B)(iv), 403; the National Environmental Policy Act of 1969, 42 U.S.C. § 4321 *et seq.*; and Section 704(b) of the Telecommunications Act of 1996, Pub. L. No. 104-104.

¹ See 5 U.S.C. § 603. The RFA, *see* 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, 110 Stat. 857 (1996).

² See 5 U.S.C. § 603(a).

³ *Id.*

⁴ National Environmental Policy Act of 1969, as amended, 42 U.S.C. §§ 4321-35.

⁵ See 47 CFR pt. 1, subpt. I.

⁶ See 47 CFR § 1.1310; 2013 *Order and Notice*, 28 FCC Rcd 3498, 3505-32, paras. 14-107 (2013).

C. Description and Estimate of the Number of Small Entities to Which the Proposed Rules Will Apply

The RFA directs agencies to provide a description of, and where feasible, an estimate of the number of small entities that may be affected by the proposed rules and policies, if adopted.⁷ The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”⁸ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.⁹ 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.¹⁰

Small Businesses. Nationwide, there are a total of approximately 29.6 million small businesses, according to the SBA.¹¹

Small Businesses, Small Organizations, and Small Governmental Jurisdictions. Our actions, over time, may affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three broad groups of small entities that could be directly affected herein.¹² First, while there are industry specific size standards for small businesses that are used in the regulatory flexibility analysis, according to data from the SBA’s Office of Advocacy, in general a small business is an independent business having fewer than 500 employees.¹³ These types of small businesses represent 99.9% of all businesses in the United States which translates to 28.8 million businesses.¹⁴

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.”¹⁵ Nationwide, as of Aug 2016, there were approximately 356,494 small organizations based on registration and tax data filed by nonprofits with the Internal Revenue Service (IRS).¹⁶

⁷ 5 U.S.C. § 603(b)(3).

⁸ 5 U.S.C. § 601(6).

⁹ 5 U.S.C. § 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.”

¹⁰ 15 U.S.C. § 632.

¹¹ See SBA, Office of Advocacy, “Frequently Asked Questions,” <http://web.sba.gov/faqs> (accessed Jan. 2009).

¹² See 5 U.S.C. § 601(3)-(6).

¹³ See SBA, Office of Advocacy, “Frequently Asked Questions, Question 1 – What is a small business?” https://www.sba.gov/sites/default/files/advocacy/SB-FAQ-2016_WEB.pdf (June 2016)

¹⁴ See SBA, Office of Advocacy, “Frequently Asked Questions, Question 2- How many small business are there in the U.S.?”, https://www.sba.gov/sites/default/files/advocacy/SB-FAQ-2016_WEB.pdf (June 2016).

¹⁵ 5 U.S.C. § 601(4).

¹⁶ Data from the Urban Institute, National Center for Charitable Statistics (NCCS) reporting on nonprofit organizations registered with the IRS was used to estimate the number of small organizations. Reports generated using the NCCS online database indicated that as of August 2016 there were 356,494 registered nonprofits with total revenues of less than \$100,000. Of this number 326,897 entities filed tax returns with 65,113 registered nonprofits reporting total revenues of \$50,000 or less on the IRS Form 990-N for Small Exempt Organizations and 261,784 nonprofits reporting total revenues of \$100,000 or less on some other version of the IRS Form 990 within 24 months of the August 2016 data release date. See <http://nccsweb.urban.org/tablewiz/bmf.php> where the report showing this

(continued....)

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.”¹⁷ U.S. Census Bureau data from the 2012 Census of Governments¹⁸ indicates that there were 90,056 local governmental jurisdictions consisting of general purpose governments and special purpose governments in the United States.¹⁹ Of this number there were 37,132 General purpose governments (county²⁰, municipal and town or township²¹) with populations of less than 50,000 and 12,184 Special purpose governments (independent school districts²² and special districts²³) with populations of less than 50,000. The 2012 U.S. Census Bureau data for most types of governments in the local government category shows that the majority of these governments have populations of less than 50,000.²⁴ Based on this data we estimate that at least 49,316 local government jurisdictions fall in the category of “small governmental jurisdictions.”²⁵

Experimental Radio Service (Other Than Broadcast). The majority of experimental licenses are

(Continued from previous page) _____

data can be generated by selecting the following data fields: Show: “Registered Nonprofit Organizations”; By: “Total Revenue Level (years 1995, Aug to 2016, Aug)”; and For: “2016, Aug” then selecting “Show Results”.

¹⁷ 5 U.S.C. § 601(5).

¹⁸ See 13 U.S.C. § 161. The Census of Government is conducted every five (5) years compiling data for years ending with “2” and “7”. See also Program Description Census of Government <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=program&id=program.en.CO G#>.

¹⁹ See U.S. Census Bureau, 2012 Census of Governments, Local Governments by Type and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG02.US01>. Local governmental jurisdictions are classified in two categories - General purpose governments (county, municipal and town or township) and Special purpose governments (special districts and independent school districts).

²⁰ See U.S. Census Bureau, 2012 Census of Governments, County Governments by Population-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG06.US01>. There were 2,114 county governments with populations less than 50,000.

²¹ See U.S. Census Bureau, 2012 Census of Governments, Subcounty General-Purpose Governments by Population-Size Group and State: 2012 - United States – States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG07.US01>. There were 18,811 municipal and 16,207 town and township governments with populations less than 50,000.

²² See U.S. Census Bureau, 2012 Census of Governments, Elementary and Secondary School Systems by Enrollment-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG11.US01>. There were 12,184 independent school districts with enrollment populations less than 50,000.

²³ See U.S. Census Bureau, 2012 Census of Governments, Special District Governments by Function and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG09.US01>. The U.S. Census Bureau data did not provide a population breakout for special district governments.

²⁴ See U.S. Census Bureau, 2012 Census of Governments, County Governments by Population-Size Group and State: 2012 - United States-States - <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG06.US01>; Subcounty General-Purpose Governments by Population-Size Group and State: 2012 - United States-States - <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG07.US01>; and Elementary and Secondary School Systems by Enrollment-Size Group and State: 2012 - United States-States. <https://factfinder.census.gov/bkmk/table/1.0/en/COG/2012/ORG11.US01>. While U.S. Census Bureau data did not provide a population breakout for special district governments, if the population of less than 50,000 for this category of local government is consistent with the other types of local governments the majority of the 38,266 special district governments have populations of less than 50,000.

²⁵ *Id.*

issued to companies such as Motorola and Department of Defense contractors such as Northrop, Lockheed and Martin Marietta. Businesses such as these may have as many as 200 licenses at one time. The majority of these applications are from entities such as these. Given this fact, the remaining 30 percent of applications, we assume, for purposes of our evaluations and conclusions in this FRFA, will be awarded to small entities, as that term is defined by the SBA.

The Commission processes approximately 1,000 applications a year for experimental radio operations. About half or 500 of these are renewals and the other half are for new licenses. We do not have adequate information to predict precisely how many of these applications will be impacted by our rule revisions. However, based on the above figures we estimate that as many as 300 of these applications could be from small entities and potentially could be impacted.

International Broadcast Stations. Commission records show that there are 19 international high frequency broadcast station authorizations. We do not request nor collect annual revenue information, and are unable to estimate the number of international high frequency broadcast stations that would constitute a small business under the SBA definition. Since all international broadcast stations operate using relatively high power levels, it is likely that they could all be impacted by our proposed rule revisions.

Satellite Telecommunications Providers. Two economic census categories address the satellite industry. The first category has a small business size standard of \$15 million or less in average annual receipts, under SBA rules.²⁶ The second has a size standard of \$25 million or less in annual receipts.²⁷ The category of Satellite Telecommunications “comprises establishments 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.”²⁸ Census Bureau data for 2007 show that 512 Satellite Telecommunications firms that operated for that entire year.²⁹ Of this total, 464 firms had annual receipts of under \$10 million, and 18 firms had receipts of \$10 million to \$24,999,999.³⁰ Consequently, the Commission estimates that the majority of Satellite Telecommunications firms are small entities that might be affected by our proposals.

The second category, i.e., “All Other Telecommunications” comprises “establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.”³¹ For this category, Census Bureau data for 2007 shows that there were a total of 2,383 firms that operated for the

²⁶ 13 CFR § 121.201, NAICS code 517410.

²⁷ 13 CFR § 121.201, NAICS code 517919.

²⁸ U.S. Census Bureau, 2007 NAICS Definitions, 517410 Satellite Telecommunications.

²⁹ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

³⁰ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

³¹ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517919&search=2007%20NAICS%20Search>.

entire year.³² Of this total, 2,347 firms had annual receipts of under \$25 million and 12 firms had annual receipts of \$25 million to \$49, 999,999.³³ Consequently, the Commission estimates that the majority of All Other Telecommunications firms are small entities that might be affected by our action.

Fixed Satellite Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Transmit/Receive Earth Stations. We do not request nor collect annual revenue information, and are unable to estimate the number of the earth stations that would constitute a small business under the SBA definition. However, the majority of these stations could be impacted by our proposed rules.

Fixed Satellite Small Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Small Transmit/Receive Earth Stations. We do not request nor collect annual revenue information, and are unable to estimate the number of fixed small satellite transmit/receive earth stations that would constitute a small business under the SBA definition. However, the majority of these stations could be impacted by our proposed rules.

Fixed Satellite Very Small Aperture Terminal (VSAT) Systems. These stations operate on a primary basis, and frequency coordination with terrestrial microwave systems is not required. Thus, a single “blanket” application may be filed for a specified number of small antennas and one or more hub stations. There are 492 current VSAT System authorizations. We do not request nor collect annual revenue information, and are unable to estimate the number of VSAT systems that would constitute a small business under the SBA definition. However, it is expected that many of these stations could be impacted by our proposed rules.

Mobile Satellite Earth Stations. There are 19 licensees. We do not request nor collect annual revenue information, and are unable to estimate the number of mobile satellite earth stations that would constitute a small business under the SBA definition. However, it is expected that many of these stations could be impacted by our proposed rules.

Wireless Telecommunications Carriers (except satellite). This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services.³⁴ The appropriate size standard under SBA rules is for the category Wireless Telecommunications Carriers. The size standard for that category is that a business is small if it has 1,500 or fewer employees.³⁵ Under the present and prior categories, the SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.³⁶ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.³⁷ Of this total, 1,368 firms had employment of 999 or

³² http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

³³ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

³⁴ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517210&search=2007%20NAICS%20Search>

³⁵ 13 CFR § 121.201, NAICS code 517210.

³⁶ 13 CFR § 121.201, NAICS code 517210. The now-superseded, pre-2007 CFR citations were 13 CFR § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

³⁷ U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

fewer employees and 15 had employment of 1000 employees or more.³⁸ Thus under this category and the associated small business size standard, , the Commission estimates that the majority of wireless telecommunications carriers(except satellite) are small entities that may be affected by our proposed action.³⁹

Licenses Assigned by Auctions. Initially, we note that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

Paging Services. Neither the SBA nor the FCC has developed a definition applicable exclusively to paging services. However, a variety of paging services is now categorized under Wireless Telecommunications Carriers (except satellite).⁴⁰ This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services. Illustrative examples in the paging context include paging services, except satellite; two-way paging communications carriers, except satellite; and radio paging services communications carriers. The SBA has deemed a paging service in this category to be small if it has 1,500 or fewer employees.⁴¹ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.⁴² Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.⁴³ Thus under this category and the associated small business size standard, , the Commission estimates that the majority of paging services in the category of wireless telecommunications carriers(except satellite) are small entities that may be affected by our proposed action.⁴⁴

In addition, in the Paging Second Report and Order, the Commission adopted a size standard for “small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.⁴⁵ A small business is an entity that, together with its affiliates and controlling principals, has average gross

³⁸ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

³⁹ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=600&-ds_name=EC0751SSSZ5&-lang=en.

⁴⁰ U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”;
<http://www.census.gov/naics/2007/def/ND517210.HTM#N517210>.

⁴¹ U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”

⁴² U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

⁴³ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

⁴⁴ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=600&-ds_name=EC0751SSSZ5&-lang=en.

⁴⁵ *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Second Report and Order, 12 FCC Rcd 2732, 2811-2812, paras. 178-181 (“*Paging Second Report and Order*”); see also *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Memorandum Opinion and Order on Reconsideration, 14 FCC Rcd 10030, 10085-10088, ¶¶ 98-107 (1999).

revenues not exceeding \$15 million for the preceding three years.⁴⁶ The SBA has approved this definition.⁴⁷ An initial auction of Metropolitan Economic Area (“MEA”) licenses was conducted in the year 2000. Of the 2,499 licenses auctioned, 985 were sold.⁴⁸ Fifty-seven companies claiming small business status won 440 licenses.⁴⁹ A subsequent auction of MEA and Economic Area (“EA”) licenses was held in the year 2001. Of the 15,514 licenses auctioned, 5,323 were sold.⁵⁰ One hundred thirty-two companies claiming small business status purchased 3,724 licenses. A third auction, consisting of 8,874 licenses in each of 175 EAs and 1,328 licenses in all but three of the 51 MEAs, was held in 2003. Seventy-seven bidders claiming small or very small business status won 2,093 licenses.⁵¹ A fourth auction of 9,603 lower and upper band paging licenses was held in the year 2010. 29 bidders claiming small or very small business status won 3,016 licenses.

2.3 GHz Wireless Communications Services. This service can be used for fixed, mobile, radiolocation, and digital audio broadcasting satellite uses. The Commission defined “small business” for the wireless communications services (“WCS”) auction as an entity with average gross revenues of \$40 million for each of the three preceding years, and a “very small business” as an entity with average gross revenues of \$15 million for each of the three preceding years.⁵² The SBA approved these definitions.⁵³ The Commission conducted an auction of geographic area licenses in the WCS service in 1997. In the auction, seven bidders that qualified as very small business entities won 31 licenses, and one bidder that qualified as a small business entity won a license.

1670-1675 MHz Services. This service can be used for fixed and mobile uses, except aeronautical mobile.⁵⁴ An auction for one license in the 1670-1675 MHz band was conducted in 2003. The Commission defined a “small business” as an entity with attributable average annual gross revenues of not more than \$40 million for the preceding three years, which would thus be eligible for a 15 percent discount on its winning bid for the 1670-1675 MHz band license. Further, the Commission defined a “very small business” as an entity with attributable average annual gross revenues of not more than \$15 million for the preceding three years, which would thus be eligible to receive a 25 percent discount on its winning bid for the 1670-1675 MHz band license. The winning bidder was not a small entity.

Wireless Telephony. Wireless telephony includes cellular, personal communications services, and specialized mobile radio telephony carriers. As noted, the SBA has developed a small business size standard for Wireless Telecommunications Carriers (except Satellite).⁵⁵ Under the SBA small business

⁴⁶ *Paging Second Report and Order*, 12 FCC Rcd at 2811, ¶ 179.

⁴⁷ See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau (“WTB”), FCC (Dec. 2, 1998) (“*Alvarez Letter 1998*”).

⁴⁸ See “929 and 931 MHz Paging Auction Closes,” Public Notice, 15 FCC Rcd 4858 (WTB 2000).

⁴⁹ See *id.*

⁵⁰ See “Lower and Upper Paging Band Auction Closes,” Public Notice, 16 FCC Rcd 21821 (WTB 2002).

⁵¹ See “Lower and Upper Paging Bands Auction Closes,” Public Notice, 18 FCC Rcd 11154 (WTB 2003). The current number of small or very small business entities that hold wireless licenses may differ significantly from the number of such entities that won in spectrum auctions due to assignments and transfers of licenses in the secondary market over time. In addition, some of the same small business entities may have won licenses in more than one auction.

⁵² *Amendment of the Commission’s Rules to Establish Part 27, the Wireless Communications Service (WCS)*, Report and Order, 12 FCC Rcd 10785, 10879, para. 194 (1997).

⁵³ See *Alvarez Letter 1998*.

⁵⁴ 47 CFR § 2.106; see generally 47 CFR §§ 27.1–.70.

⁵⁵ 13 CFR § 121.201, NAICS code 517210.

size standard, a business is small if it has 1,500 or fewer employees.⁵⁶ Census data for 2007 shows that there were 1,383 firms that operated that year.⁵⁷ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small. According to Trends in Telephone Service data, 434 carriers reported that they were engaged in wireless telephony.⁵⁸ Of these, an estimated 222 have 1,500 or fewer employees and 212 have more than 1,500 employees.⁵⁹ Therefore, approximately half of these entities can be considered small. Similarly, according to Commission data, 413 carriers reported that they were engaged in the provision of wireless telephony, including cellular service, Personal Communications Service (PCS), and Specialized Mobile Radio (SMR) Telephony services.⁶⁰ Of these, an estimated 261 have 1,500 or fewer employees and 152 have more than 1,500 employees.⁶¹ Consequently, the Commission estimates that approximately half or more of these firms can be considered small. Thus, using available data, we estimate that the majority of wireless firms can be considered small.

Broadband Personal Communications Service. *Broadband Personal Communications Service.* The broadband personal communications services (PCS) spectrum is divided into six frequency blocks designated A through F, and the Commission has held auctions for each block. The Commission initially defined a “small business” for C- and F-Block licenses as an entity that has average gross revenues of \$40 million or less in the three previous years.⁶² For F-Block licenses, an additional small business size standard for “very small business” was added and is defined as an entity that, together with its affiliates, has average gross revenues of not more than \$15 million for the preceding three years.⁶³ These small business size standards, in the context of broadband PCS auctions, have been approved by the SBA.⁶⁴ No small businesses within the SBA-approved small business size standards bid successfully for licenses in Blocks A and B. There were 90 winning bidders that claimed small business status in the first two C-Block auctions. A total of 93 bidders that claimed small and very small business status won approximately 40 percent of the 1,479 licenses in the first auction for the D, E, and F Blocks.⁶⁵ On April 15, 1999, the Commission completed the re-auction of 347 C-, D-, E-, and F-Block licenses in Auction No. 22.⁶⁶ Of the 57 winning bidders in that auction, 48 claimed small business status and won 277 licenses.

⁵⁶ *Id.*

⁵⁷ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

⁵⁸ *Trends in Telephone Service*, at Tbl. 5.3.

⁵⁹ *Id.*

⁶⁰ *See Trends in Telephone Service*, at Tbl. 5.3.

⁶¹ *See id.*

⁶² *See Amendment of Parts 20 and 24 of the Commission’s Rules – Broadband PCS Competitive Bidding and the Commercial Mobile Radio Service Spectrum Cap; Amendment of the Commission’s Cellular/PCS Cross-Ownership Rule*, WT Docket No. 96-59, GN Docket No. 90-314, Report and Order, 11 FCC Rcd 7824, 7850–52 ¶¶ 57–60 (1996) (“*PCS Report and Order*”); *see also* 47 CFR § 24.720(b).

⁶³ *See PCS Report and Order*, 11 FCC Rcd at 7852 ¶ 60.

⁶⁴ *See Alvarez Letter 1998*.

⁶⁵ *See Broadband PCS, D, E and F Block Auction Closes*, Public Notice, Doc. No. 89838 (rel. Jan. 14, 1997).

⁶⁶ *See C, D, E, and F Block Broadband PCS Auction Closes*, Public Notice, 14 FCC Rcd 6688 (WTB 1999). Before Auction No. 22, the Commission established a very small standard for the C Block to match the standard used for F Block. *Amendment of the Commission’s Rules Regarding Installment Payment Financing for Personal*

(continued....)

On January 26, 2001, the Commission completed the auction of 422 C and F Block Broadband PCS licenses in Auction No. 35. Of the 35 winning bidders in that auction, 29 claimed small business status.⁶⁷ Subsequent events concerning Auction 35, including judicial and agency determinations, resulted in a total of 163 C and F Block licenses being available for grant. On February 15, 2005, the Commission completed an auction of 242 C-, D-, E-, and F-Block licenses in Auction No. 58. Of the 24 winning bidders in that auction, 16 claimed small business status and won 156 licenses.⁶⁸ On May 21, 2007, the Commission completed an auction of 33 licenses in the A, C, and F Blocks in Auction No. 71.⁶⁹ Of the 14 winning bidders in that auction, six claimed small business status and won 18 licenses.⁷⁰ On August 20, 2008, the Commission completed the auction of 20 C-, D-, E-, and F-Block Broadband PCS licenses in Auction No. 78.⁷¹ Of the eight winning bidders for Broadband PCS licenses in that auction, six claimed small business status and won 14 licenses.⁷²

Advanced Wireless Services. In 2006, the Commission conducted its first auction of Advanced Wireless Services licenses in the 1710-1755 MHz and 2110-2155 MHz bands (“AWS-1”), designated as Auction 66.⁷³ For the AWS-1 bands, the Commission has defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million, and a “very small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$15 million.⁷⁴ In 2006, the Commission conducted its first auction of AWS-1 licenses.⁷⁵ In that initial AWS-1 auction, 31 winning bidders identified themselves as very small businesses won 142 licenses.⁷⁶ Twenty-six of the winning bidders identified themselves as small businesses and won 73 licenses.⁷⁷ In a

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Communications Services (PCS) Licensees, WT Docket No. 97-82, Fourth Report and Order, 13 FCC Rcd 15743, 15768 ¶ 46 (1998).

⁶⁷ See *C and F Block Broadband PCS Auction Closes; Winning Bidders Announced*, Public Notice, 16 FCC Rcd 2339 (2001).

⁶⁸ See *Broadband PCS Spectrum Auction Closes; Winning Bidders Announced for Auction No. 58*, Public Notice, 20 FCC Rcd 3703 (2005).

⁶⁹ See *Auction of Broadband PCS Spectrum Licenses Closes; Winning Bidders Announced for Auction No. 71*, Public Notice, 22 FCC Rcd 9247 (2007).

⁷⁰ *Id.*

⁷¹ See *Auction of AWS-1 and Broadband PCS Licenses Closes; Winning Bidders Announced for Auction 78*, Public Notice, 23 FCC Rcd 12749 (WTB 2008).

⁷² *Id.*

⁷³ See *Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66*, AU Docket No. 06-30, *Public Notice*, 21 FCC Rcd 4562 (2006) (“*Auction 66 Procedures Public Notice*”);

⁷⁴ See *Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, Report and Order*, 18 FCC Rcd 25,162, App. B (2003), *modified by Service Rules for Advanced Wireless Services In the 1.7 GHz and 2.1 GHz Bands, Order on Reconsideration*, 20 FCC Rcd 14,058, App. C (2005).

⁷⁵ See *Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66*, AU Docket No. 06-30, *Public Notice*, 21 FCC Rcd 4562 (2006) (“*Auction 66 Procedures Public Notice*”).

⁷⁶ See *Auction of Advanced Wireless Services Licenses Closes; Winning Bidders Announced for Auction No. 66*, *Public Notice*, 21 FCC Rcd 10,521 (2006) (“*Auction 66 Closing Public Notice*”).

⁷⁷ See *id.*

subsequent 2008 auction, the Commission offered 35 AWS-1 licenses.⁷⁸ Four winning bidders identified themselves as very small businesses, and three of the winning bidders identifying themselves as a small businesses won five AWS-1 licenses.⁷⁹

Narrowband Personal Communications Services. In 1994, the Commission conducted two auctions of Narrowband PCS licenses. For these auctions, the Commission defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million.⁸⁰ Through these auctions, the Commission awarded a total of 41 licenses, 11 of which were obtained by four small businesses.⁸¹ To ensure meaningful participation by small business entities in future auctions, the Commission adopted a two-tiered small business size standard in the *Narrowband PCS Second Report and Order*.⁸² A “small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$40 million.⁸³ A “very small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$15 million.⁸⁴ The SBA has approved these small business size standards.⁸⁵ A third auction of Narrowband PCS licenses was conducted in 2001. In that auction, five bidders won 317 (Metropolitan Trading Areas and nationwide) licenses.⁸⁶ Three of the winning bidders claimed status as a small or very small entity and won 311 licenses.

Lower 700 MHz Band Licenses. The Commission previously adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits.⁸⁷ The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁸⁸ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁸⁹

⁷⁸ See *AWS-1 and Broadband PCS Procedures Public Notice*, 23 FCC Rcd at 7499. Auction 78 also included an auction of broadband PCS licenses.

⁷⁹ See *Auction of AWS-1 and Broadband PCS Licenses Closes, Winning Bidders Announced for Auction 78, Down Payments Due September 9, 2008, FCC Forms 601 and 602 Due September 9, 2008, Final Payments Due September 23, 2008, Ten-Day Petition to Deny Period*, Public Notice, 23 FCC Rcd 12,749 (2008).

⁸⁰ *Implementation of Section 309(j) of the Communications Act – Competitive Bidding Narrowband PCS*, Third Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 10 FCC Rcd 175, 196, para. 46 (1994).

⁸¹ See “Announcing the High Bidders in the Auction of Ten Nationwide Narrowband PCS Licenses, Winning Bids Total \$617,006,674,” *Public Notice*, PNWL 94-004 (rel. Aug. 2, 1994); “Announcing the High Bidders in the Auction of 30 Regional Narrowband PCS Licenses; Winning Bids Total \$490,901,787,” *Public Notice*, PNWL 94-27 (rel. Nov. 9, 1994).

⁸² *Amendment of the Commission’s Rules to Establish New Personal Communications Services, Narrowband PCS, Second Report and Order and Second Further Notice of Proposed Rule Making*, 15 FCC Rcd 10456, 10476, para. 40 (2000) (“*Narrowband PCS Second Report and Order*”).

⁸³ *Narrowband PCS Second Report and Order*, 15 FCC Rcd at 10476, para. 40.

⁸⁴ *Id.*

⁸⁵ See *Alvarez Letter 1998*.

⁸⁶ See “Narrowband PCS Auction Closes,” *Public Notice*, 16 FCC Rcd 18663 (WTB 2001).

⁸⁷ See *Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, Report and Order, 17 FCC Rcd 1022 (2002) (“*Channels 52-59 Report and Order*”).

⁸⁸ See *Channels 52-59 Report and Order*, 17 FCC Rcd at 1087-88, ¶ 172.

⁸⁹ See *id.*

Additionally, the Lower 700 MHz Service had a third category of small business status for Metropolitan/Rural Service Area (“MSA/RSA”) licenses —“entrepreneur”— which is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$3 million for the preceding three years.⁹⁰ The SBA approved these small size standards.⁹¹ An auction of 740 licenses was conducted in 2002 (one license in each of the 734 MSAs/RSAs and one license in each of the six Economic Area Groupings (EAGs)). Of the 740 licenses available for auction, 484 licenses were won by 102 winning bidders. Seventy-two of the winning bidders claimed small business, very small business, or entrepreneur status and won a total of 329 licenses.⁹² A second auction commenced on May 28, 2003, closed on June 13, 2003, and included 256 licenses.⁹³ Seventeen winning bidders claimed small or very small business status and won 60 licenses, and nine winning bidders claimed entrepreneur status and won 154 licenses.⁹⁴ In 2005, the Commission completed an auction of 5 licenses in the lower 700 MHz band (Auction 60). All three winning bidders claimed small business status.

In 2007, the Commission reexamined its rules governing the 700 MHz band in the *700 MHz Second Report and Order*.⁹⁵ An auction of A, B and E block licenses in the Lower 700 MHz band was held in 2008.⁹⁶ Twenty winning bidders claimed small business status (those with attributable average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years). Thirty three winning bidders claimed very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years). In 2011, the Commission conducted Auction 92, which offered 16 lower 700 MHz band licenses that had been made available in Auction 73 but either remained unsold or were licenses on which a winning bidder defaulted. Two of the seven winning bidders in Auction 92 claimed very small business status, winning a total of four licenses.

Upper 700 MHz Band Licenses. In the *700 MHz Second Report and Order*, the Commission revised its rules regarding Upper 700 MHz licenses.⁹⁷ On January 24, 2008, the Commission commenced Auction 73 in which several licenses in the Upper 700 MHz band were available for licensing: 12 Regional Economic Area Grouping licenses in the C Block, and one nationwide license in the D Block.⁹⁸ The auction concluded on March 18, 2008, with 3 winning bidders claiming very small business status (those

⁹⁰ See *id.*, 17 FCC Rcd at 1088, ¶ 173.

⁹¹ See Letter from Aida Alvarez, Administrator, SBA, to Thomas Sugrue, Chief, WTB, FCC (Aug. 10, 1999) (“*Alvarez Letter 1999*”).

⁹² See “Lower 700 MHz Band Auction Closes,” *Public Notice*, 17 FCC Rcd 17272 (WTB 2002).

⁹³ See Lower 700 MHz Band Auction Closes, *Public Notice*, 18 FCC Rcd 11873 (WTB 2003).

⁹⁴ See *id.*

⁹⁵ Service Rules for the 698-746, 747-762 and 777-792 MHz Band, WT Docket No. 06-150, *Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, CC Docket No. 94-102, Section 68.4(a) of the Commission’s Rules Governing Hearing Aid-Compatible Telephone, WT Docket No. 01-309, *Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services*, WT Docket No. 03-264, *Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission’s Rules*, WT Docket No. 06-169, *Implementing a Nationwide, Broadband Interoperable Public Safety Network in the 700 MHz Band*, PS Docket No. 06-229, *Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State, and Local Public Safety Communications Requirements Through the Year 2010*, WT Docket No. 96-86, *Second Report and Order*, 22 FCC Rcd 15289 (2007) (“*700 MHz Second Report and Order*”).

⁹⁶ See Auction of 700 MHz Band Licenses Closes, *Public Notice*, 23 FCC Rcd 4572 (WTB 2008).

⁹⁷ *700 MHz Second Report and Order*, 22 FCC Rcd 15289.

⁹⁸ See Auction of 700 MHz Band Licenses Closes, *Public Notice*, 23 FCC Rcd 4572 (WTB 2008).

with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years) and winning five licenses.

700 MHz Guard Band Licenses. In 2000, the Commission adopted the *700 MHz Guard Band Report and Order*, in which it established rules for the A and B block licenses in the Upper 700 MHz band, including size standards for “small businesses” and “very small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.⁹⁹ A small business in this service is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.¹⁰⁰ Additionally, a very small business is an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.¹⁰¹ SBA approval of these definitions is not required.¹⁰² An auction of these licenses was conducted in 2000.¹⁰³ Of the 104 licenses auctioned, 96 licenses were won by nine bidders. Five of these bidders were small businesses that won a total of 26 licenses. A second auction of 700 MHz Guard Band licenses was held in 2001. All eight of the licenses auctioned were sold to three bidders. One of these bidders was a small business that won a total of two licenses.¹⁰⁴

Specialized Mobile Radio. The Commission adopted small business size standards for the purpose of determining eligibility for bidding credits in auctions of Specialized Mobile Radio (SMR) geographic area licenses in the 800 MHz and 900 MHz bands. The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.¹⁰⁵ The Commission defined a “very small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$3 million for the preceding three years.¹⁰⁶ The SBA has approved these small business size standards for both the 800 MHz and 900 MHz SMR Service.¹⁰⁷ The first 900 MHz SMR auction was completed in 1996. Sixty bidders claiming that they qualified as small businesses under the \$15 million size standard won 263 licenses in the 900 MHz SMR band. In 2004, the Commission held a second auction of 900 MHz SMR licenses and three winning bidders identifying themselves as very small businesses won 7 licenses.¹⁰⁸ The auction of 800 MHz SMR licenses for the upper 200 channels was conducted in 1997. Ten bidders claiming that they qualified as small or very small businesses under the \$15 million size standard won 38 licenses for the upper 200 channels.¹⁰⁹ A second auction of 800 MHz SMR licenses was

⁹⁹ See *Service Rules for the 746-764 MHz Bands, and Revisions to Part 27 of the Commission’s Rules*, Second Report and Order, 15 FCC Rcd 5299 (2000) (“*700 MHz Guard Band Report and Order*”).

¹⁰⁰ See *700 MHz Guard Band Report and Order*, 15 FCC Rcd at 5343, para. 108.

¹⁰¹ See *id.*

¹⁰² See *id.*, 15 FCC Rcd 5299, 5343, para. 108 n.246 (for the 746-764 MHz and 776-794 MHz bands, the Commission is exempt from 15 U.S.C. § 632, which requires Federal agencies to obtain SBA approval before adopting small business size standards).

¹⁰³ See “700 MHz Guard Bands Auction Closes: Winning Bidders Announced,” *Public Notice*, 15 FCC Rcd 18026 (2000).

¹⁰⁴ See “700 MHz Guard Bands Auction Closes: Winning Bidders Announced,” *Public Notice*, 16 FCC Rcd 4590 (WTB 2001).

¹⁰⁵ 47 CFR §§ 90.810, 90.814(b), 90.912.

¹⁰⁶ 47 CFR §§ 90.810, 90.814(b), 90.912.

¹⁰⁷ See *Alvarez Letter 1999*.

¹⁰⁸ See 900 MHz Specialized Mobile Radio Service Spectrum Auction Closes: Winning Bidders Announced,” *Public Notice*, 19 FCC Rcd 3921 (WTB 2004).

¹⁰⁹ See “Correction to Public Notice DA 96-586 ‘FCC Announces Winning Bidders in the Auction of 1020 Licenses to Provide 900 MHz SMR in Major Trading Areas,’” *Public Notice*, 18 FCC Rcd 18367 (WTB 1996).

conducted in 2002 and included 23 BEA licenses. One bidder claiming small business status won five licenses.¹¹⁰

The auction of the 1,053 800 MHz SMR licenses for the General Category channels was conducted in 2000. Eleven bidders who won 108 licenses for the General Category channels in the 800 MHz SMR band qualified as small or very small businesses.¹¹¹ In an auction completed in 2000, a total of 2,800 Economic Area licenses in the lower 80 channels of the 800 MHz SMR service were awarded.¹¹² Of the 22 winning bidders, 19 claimed small or very small business status and won 129 licenses. Thus, combining all four auctions, 41 winning bidders for geographic licenses in the 800 MHz SMR band claimed to be small businesses.

In addition, there are numerous incumbent site-by-site SMR licensees and licensees with extended implementation authorizations in the 800 and 900 MHz bands. We do not know how many firms provide 800 MHz or 900 MHz geographic area SMR pursuant to extended implementation authorizations, nor how many of these providers have annual revenues not exceeding \$15 million. One firm has over \$15 million in revenues. In addition, we do not know how many of these firms have 1500 or fewer employees.¹¹³ We assume, for purposes of this analysis, that all of the remaining existing extended implementation authorizations are held by small entities, as that small business size standard is approved by the SBA.

220 MHz Radio Service – Phase I Licensees. The 220 MHz service has both Phase I and Phase II licenses. Phase I licensing was conducted by lotteries in 1992 and 1993. There are approximately 1,515 such non-nationwide licensees and four nationwide licensees currently authorized to operate in the 220 MHz band. The Commission has not developed a small business size standard for small entities specifically applicable to such incumbent 220 MHz Phase I licensees. To estimate the number of such licensees that are small businesses, the Commission applies the small business size standard under the SBA rules applicable. The SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.¹¹⁴ For this service, the SBA uses the category of Wireless Telecommunications Carriers (except Satellite). Census data for 2007, which supersede data contained in the 2002 Census, show that there were 1,383 firms that operated that year.¹¹⁵ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms can be considered small.

220 MHz Radio Service – Phase II Licensees. The 220 MHz service has both Phase I and Phase II licenses. The Phase II 220 MHz service licenses are assigned by auction, where mutually exclusive applications are accepted. In the *220 MHz Third Report and Order*, the Commission adopted a small business size standard for defining “small” and “very small” businesses for purposes of determining their

¹¹⁰ See “Multi-Radio Service Auction Closes,” *Public Notice*, 17 FCC Rcd 1446 (WTB 2002).

¹¹¹ See “800 MHz Specialized Mobile Radio (SMR) Service General Category (851-854 MHz) and Upper Band (861-865 MHz) Auction Closes; Winning Bidders Announced,” *Public Notice*, 15 FCC Rcd 17162 (2000).

¹¹² See, “800 MHz SMR Service Lower 80 Channels Auction Closes; Winning Bidders Announced,” *Public Notice*, 16 FCC Rcd 1736 (2000).

¹¹³ See generally 13 CFR § 121.201, NAICS code 517210.

¹¹⁴ 13 CFR § 121.201, NAICS code 517210 (2007 NAICS). The now-superseded, pre-2007 CFR citations were 13 CFR § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

¹¹⁵ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

eligibility for special provisions such as bidding credits.¹¹⁶ This small business standard indicates that a “small business” is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.¹¹⁷ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that do not exceed \$3 million for the preceding three years.¹¹⁸ The SBA has approved these small size standards.¹¹⁹ Auctions of Phase II licenses commenced on and closed in 1998.¹²⁰ In the first auction, 908 licenses were auctioned in three different sized geographic areas: three nationwide licenses, 30 Regional Economic Area Group (EAG) Licenses, and 875 Economic Area (EA) Licenses. Of the 908 licenses auctioned, 693 were sold.¹²¹ Thirty-nine small businesses won 373 licenses in the first 220 MHz auction. A second auction included 225 licenses: 216 EA licenses and 9 EAG licenses. Fourteen companies claiming small business status won 158 licenses.¹²² A third auction included four licenses: 2 BEA licenses and 2 EAG licenses in the 220 MHz Service. No small or very small business won any of these licenses.¹²³ In 2007, the Commission conducted a fourth auction of the 220 MHz licenses, designated as Auction 72.¹²⁴ Auction 72, which offered 94 Phase II 220 MHz Service licenses, concluded in 2007.¹²⁵ In this auction, five winning bidders won a total of 76 licenses. Two winning bidders identified themselves as very small businesses won 56 of the 76 licenses. One of the winning bidders that identified themselves as a small business won 5 of the 76 licenses won.

Private Land Mobile Radio (“PLMR”). PLMR systems serve an essential role in a range of industrial, business, land transportation, and public safety activities. These radios are used by companies of all sizes operating in all U.S. business categories, and are often used in support of the licensee’s primary (non-telecommunications) business operations. For the purpose of determining whether a licensee of a PLMR system is a small business as defined by the SBA, we use the broad census category, Wireless Telecommunications Carriers (except Satellite). This definition provides that a small entity is any such entity employing no more than 1,500 persons.¹²⁶ The Commission does not require PLMR licensees to disclose information about number of employees, so the Commission does not have information that could be used to determine how many PLMR licensees constitute small entities under this definition. We note that PLMR licensees generally use the licensed facilities in support of other business activities, and

¹¹⁶ *Amendment of Part 90 of the Commission’s Rules to Provide for the Use of the 220-222 MHz Band by the Private Land Mobile Radio Service*, Third Report and Order, 12 FCC Rcd 10943, 11068-70 ¶¶ 291-295 (1997).

¹¹⁷ *Id.* at 11068 ¶ 291.

¹¹⁸ *Id.*

¹¹⁹ See Letter to Daniel Phythyon, Chief, Wireless Telecommunications Bureau, Federal Communications Commission, from Aida Alvarez, Administrator, Small Business Administration, dated January 6, 1998 (*Alvarez to Phythyon Letter 1998*).

¹²⁰ See generally *220 MHz Service Auction Closes*, Public Notice, 14 FCC Rcd 605 (WTB 1998).

¹²¹ See *FCC Announces It is Prepared to Grant 654 Phase II 220 MHz Licenses After Final Payment is Made*, Public Notice, 14 FCC Rcd 1085 (WTB 1999).

¹²² See *Phase II 220 MHz Service Spectrum Auction Closes*, Public Notice, 14 FCC Rcd 11218 (WTB 1999).

¹²³ See *Multi-Radio Service Auction Closes*, Public Notice, 17 FCC Rcd 1446 (WTB 2002).

¹²⁴ See “Auction of Phase II 220 MHz Service Spectrum Scheduled for June 20, 2007, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction 72, *Public Notice*, 22 FCC Rcd 3404 (2007).

¹²⁵ See *Auction of Phase II 220 MHz Service Spectrum Licenses Closes, Winning Bidders Announced for Auction 72, Down Payments due July 18, 2007, FCC Forms 601 and 602 due July 18, 2007, Final Payments due August 1, 2007, Ten-Day Petition to Deny Period*, Public Notice, 22 FCC Rcd 11573 (2007).

¹²⁶ See 13 CFR § 121.201, NAICS code 517210.

therefore, it would also be helpful to assess PLMR licensees under the standards applied to the particular industry subsector to which the licensee belongs.¹²⁷

As of March 2010, there were 424,162 PLMR licensees operating 921,909 transmitters in the PLMR bands below 512 MHz. We note that any entity engaged in a commercial activity is eligible to hold a PLMR license, and that any revised rules in this context could therefore potentially impact small entities covering a great variety of industries.

Fixed Microwave Services. Microwave services include common carrier,¹²⁸ private-operational fixed,¹²⁹ and broadcast auxiliary radio services.¹³⁰ They also include the Local Multipoint Distribution Service (LMDS),¹³¹ the Digital Electronic Message Service (DEMS),¹³² and the 24 GHz Service,¹³³ where licensees can choose between common carrier and non-common carrier status.¹³⁴ At present, there are approximately 36,708 common carrier fixed licensees and 59,291 private operational-fixed licensees and broadcast auxiliary radio licensees in the microwave services. There are approximately 135 LMDS licensees, three DEMS licensees, and three 24 GHz licensees. The Commission has not yet defined a small business with respect to microwave services. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite) and the appropriate size standard for this category under SBA rules is that such a business is small if it has 1,500 or fewer employees.¹³⁵ For this industry, U.S. Census data for 2012 shows that there were 967 firms that operated for the entire year.¹³⁶ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹³⁷ Thus under this SBA category and the associated size standard, the Commission estimates that a majority of fixed microwave service licensees can be considered small.

The Commission does not have data specifying the number of these licensees that have more than 1,500 employees, and thus is unable at this time to estimate with greater precision the number of fixed microwave service licensees that would qualify as small business concerns under the SBA's small business size standard. Consequently, the Commission estimates that there are up to 36,708 common carrier fixed licensees and up to 59,291 private operational-fixed licensees and broadcast auxiliary radio licensees in the microwave services that may be small and may be affected by the rules and policies

¹²⁷ See generally 13 CFR § 121.201.

¹²⁸ See 47 CFR Part 101, Subparts C and I.

¹²⁹ See 47 CFR Part 101, Subparts C and H.

¹³⁰ 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.

¹³¹ See 47 CFR Part 101, Subpart L.

¹³² See 47 CFR Part 101, Subpart G.

¹³³ See *id.*

¹³⁴ See 47 CFR §§ 101.533, 101.1017.

¹³⁵ See 13 CFR § 121.201, NAICS code 517210.

¹³⁶ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series, "Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210" (rel. Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹³⁷ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

adopted herein. We note, however, that the common carrier microwave fixed licensee category does include some large entities.

39 GHz Service. The Commission adopted small business size standards for 39 GHz licenses. A “small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million in the preceding three years.¹³⁸ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues of not more than \$15 million for the preceding three years.¹³⁹ The SBA has approved these small business size standards.¹⁴⁰ In 2000, the Commission conducted an auction of 2,173 39 GHz licenses. A total of 18 bidders who claimed small or very small business status won 849 licenses.

Local Multipoint Distribution Service. Local Multipoint Distribution Service (“LMDS”) is a fixed broadband point-to-multipoint microwave service that provides for two-way video telecommunications.¹⁴¹ The Commission established a small business size standard for LMDS licenses as an entity that has average gross revenues of less than \$40 million in the three previous years.¹⁴² An additional small business size standard for “very small business” was added as an entity that, together with its affiliates, has average gross revenues of not more than \$15 million for the preceding three years.¹⁴³ The SBA has approved these small business size standards in the context of LMDS auctions.¹⁴⁴ There were 93 winning bidders that qualified as small entities in the LMDS auctions. A total of 93 small and very small business bidders won approximately 277 A Block licenses and 387 B Block licenses. In 1999, the Commission re-auctioned 161 licenses; there were 32 small and very small businesses winning that won 119 licenses.

218-219 MHz Service. The first auction of 218-219 MHz Service (previously referred to as the Interactive and Video Data Service or IVDS) licenses resulted in 170 entities winning licenses for 594 Metropolitan Statistical Areas (“MSAs”).¹⁴⁵ Of the 594 licenses, 557 were won by 167 entities qualifying as a small business. For that auction, the Commission defined a small business as an entity that, together with its affiliates, has no more than a \$6 million net worth and, after federal income taxes (excluding any carry over losses), has no more than \$2 million in annual profits each year for the previous two years.¹⁴⁶ In the *218-219 MHz Report and Order and Memorandum Opinion and Order*, the Commission revised its small business size standards for the 218-219 MHz Service and defined a small business as an entity that,

¹³⁸ See *Amendment of the Commission’s Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz Bands*, ET Docket No. 95-183, Report and Order, 12 FCC Rcd 18600 (1997).

¹³⁹ *Id.*

¹⁴⁰ See Letter from Aida Alvarez, Administrator, SBA, to Kathleen O’Brien Ham, Chief, Auctions and Industry Analysis Division, WTB, FCC (Feb. 4, 1998); see Letter from Hector Barreto, Administrator, SBA, to Margaret Wiener, Chief, Auctions and Industry Analysis Division, WTB, FCC (Jan. 18, 2002).

¹⁴¹ See [Rulemaking to Amend Parts 1, 2, 21, 25, of the Commission’s Rules to Redesignate the 27.5-29.5 GHz Frequency Band, Reallocate the 29.5-30.5 Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services](#), CC Docket No. 92-297, Second Report and Order, Order on Reconsideration, and Fifth Notice of Proposed Rule Making, 12 FCC Rcd 12545, 12689-90, para. 348 (1997) (“LMDS Second Report and Order”).

¹⁴² See [LMDS Second Report and Order](#), 12 FCC Rcd at 12689-90, para. 348.

¹⁴³ See *id.*

¹⁴⁴ See Alvarez to Phythyon Letter 1998.

¹⁴⁵ See “Interactive Video and Data Service (IVDS) Applications Accepted for Filing,” Public Notice, 9 FCC Rcd 6227 (1994).

¹⁴⁶ *Implementation of Section 309(j) of the Communications Act – Competitive Bidding*, Fourth Report and Order, 9 FCC Rcd 2330 (1994).

together with its affiliates and persons or entities that hold interests in such an entity and their affiliates, has average annual gross revenues not exceeding \$15 million for the preceding three years.¹⁴⁷ The Commission defined a “very small business” as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and its affiliates, has average annual gross revenues not exceeding \$3 million for the preceding three years.¹⁴⁸ The SBA has approved these definitions.¹⁴⁹

Location and Monitoring Service (“LMS”). Multilateration LMS systems use non-voice radio techniques to determine the location and status of mobile radio units. For auctions of LMS licenses, the Commission has defined a “small business” as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$15 million.¹⁵⁰ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$3 million.¹⁵¹ These definitions have been approved by the SBA.¹⁵² An auction of LMS licenses was conducted in 1999. Of the 528 licenses auctioned, 289 licenses were sold to four small businesses.

Rural Radiotelephone Service. The Commission has not adopted a size standard for small businesses specific to the Rural Radiotelephone Service.¹⁵³ A significant subset of the Rural Radiotelephone Service is the Basic Exchange Telephone Radio System (“BETRS”).¹⁵⁴ For purposes of its analysis of the Rural Radiotelephone Service, the Commission uses the SBA small business size standard for the category Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁵⁵ Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁵⁶ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus under this category and the associated small business size standard, the majority of firms in the Rural Radiotelephone Service can be considered small.

Air-Ground Radiotelephone Service.¹⁵⁷ The Commission has previously used the SBA’s small business definition applicable to Wireless Telecommunications Carriers (except Satellite), *i.e.*, an entity employing no more than 1,500 persons.¹⁵⁸ There are approximately 100 licensees in the Air-Ground Radiotelephone Service, and under that definition, we estimate that almost all of them qualify as small entities under the SBA definition. For purposes of assigning Air-Ground Radiotelephone Service licenses

¹⁴⁷ *Amendment of Part 95 of the Commission’s Rules to Provide Regulatory Flexibility in the 218-219 MHz Service*, Report and Order and Memorandum Opinion and Order, 15 FCC Rcd 1497 (1999).

¹⁴⁸ *Id.*

¹⁴⁹ *See Alvarez to Phythyon Letter 1998.*

¹⁵⁰ *Amendment of Part 90 of the Commission’s Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Second Report and Order, 13 FCC Rcd 15182, 15192, ¶ 20 (1998) (“*Automatic Vehicle Monitoring Systems Second Report and Order*”); *see also* 47 CFR § 90.1103.

¹⁵¹ *Automatic Vehicle Monitoring Systems Second Report and Order*, 13 FCC Rcd at 15192, para. 20; *see also* 47 CFR § 90.1103.

¹⁵² *See Alvarez Letter 1998.*

¹⁵³ The service is defined in section 22.99 of the Commission’s Rules, 47 CFR § 22.99.

¹⁵⁴ BETRS is defined in sections 22.757 and 22.759 of the Commission’s Rules, 47 CFR §§ 22.757 and 22.759.

¹⁵⁵ 13 CFR § 121.201, NAICS code 517210.

¹⁵⁶ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-_skip=700&-ds_name=EC0751SSSZ5&-_lang=en.

¹⁵⁷ The service is defined in § 22.99 of the Commission’s Rules, 47 CFR § 22.99.

¹⁵⁸ 13 CFR § 121.201, NAICS codes 517210.

through competitive bidding, the Commission has defined “small business” as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$40 million.¹⁵⁹ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$15 million.¹⁶⁰ These definitions were approved by the SBA.¹⁶¹ In 2006, the Commission completed an auction of nationwide commercial Air-Ground Radiotelephone Service licenses in the 800 MHz band (Auction 65). The auction closed with two winning bidders winning two Air-Ground Radiotelephone Services licenses. Neither of the winning bidders claimed small business status.

Aviation and Marine Radio Services. Small businesses in the aviation and marine radio services use a very high frequency (“VHF”) marine or aircraft radio and, as appropriate, an emergency position-indicating radio beacon (and/or radar) or an emergency locator transmitter. The Commission has not developed a small business size standard specifically applicable to these small businesses. For purposes of this analysis, the Commission uses the SBA small business size standard for the category Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁶² Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁶³ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus, under this category and the associated small business size standard, the majority of firms can be considered small.

Offshore Radiotelephone Service. This service operates on several UHF television broadcast channels that are not used for television broadcasting in the coastal areas of states bordering the Gulf of Mexico.¹⁶⁴ There are presently approximately 55 licensees in this service. The Commission is unable to estimate at this time the number of licensees that would qualify as small under the SBA’s small business size standard for the category of Wireless Telecommunications Carriers (except Satellite). Under that standard.¹⁶⁵ Under that SBA small business size standard, a business is small if it has 1,500 or fewer employees.¹⁶⁶ Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁶⁷ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus, under this category and the associated small business size standard, the majority of firms can be considered small.

Multiple Address Systems (“MAS”). Entities using MAS spectrum, in general, fall into two categories:

¹⁵⁹ *Amendment of Part 22 of the Commission’s Rules to Benefit the Consumers of Air-Ground Telecommunications Services, Biennial Regulatory Review – Amendment of Parts 1, 22, and 90 of the Commission’s Rules, Amendment of Parts 1 and 22 of the Commission’s Rules to Adopt Competitive Bidding Rules for Commercial and General Aviation Air-Ground Radiotelephone Service*, WT Docket Nos. 03-103 and 05-42, Order on Reconsideration and Report and Order, 20 FCC Rcd 19663, ¶¶ 28-42 (2005).

¹⁶⁰ *Id.*

¹⁶¹ See Letter from Hector V. Barreto, Administrator, SBA, to Gary D. Michaels, Deputy Chief, Auctions and Spectrum Access Division, WTB, FCC (Sept. 19, 2005).

¹⁶² 13 CFR § 121.201, NAICS code 517210.

¹⁶³ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-lang=en.

¹⁶⁴ This service is governed by Subpart I of Part 22 of the Commission’s Rules. See 47 CFR §§ 22.1001-22.1037.

¹⁶⁵ 13 CFR § 121.201, NAICS code 517210.

¹⁶⁶ *Id.*

¹⁶⁷ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-lang=en.

(1) those using the spectrum for profit-based uses, and (2) those using the spectrum for private internal uses. The Commission defines a small business for MAS licenses as an entity that has average gross revenues of less than \$15 million in the preceding three years.¹⁶⁸ A very small business is defined as an entity that, together with its affiliates, has average gross revenues of not more than \$3 million for the preceding three years.¹⁶⁹ The SBA has approved these definitions.¹⁷⁰ The majority of these entities will most likely be licensed in bands where the Commission has implemented a geographic area licensing approach that would require the use of competitive bidding procedures to resolve mutually exclusive applications. The Commission's licensing database indicates that, as of March 5, 2010, there were over 11,500 MAS station authorizations. In 2001, an auction of 5,104 MAS licenses in 176 EAs was conducted.¹⁷¹ Seven winning bidders claimed status as small or very small businesses and won 611 licenses. In 2005, the Commission completed an auction (Auction 59) of 4,226 MAS licenses in the Fixed Microwave Services from the 928/959 and 932/941 MHz bands. Twenty-six winning bidders won a total of 2,323 licenses. Of the 26 winning bidders in this auction, five claimed small business status and won 1,891 licenses.

With respect to entities that use, or seek to use, MAS spectrum to accommodate internal communications needs, we note that MAS serves an essential role in a range of industrial, safety, business, and land transportation activities. MAS radios are used by companies of all sizes, operating in virtually all U.S. business categories, and by all types of public safety entities. For the majority of private internal users, the small business size standard developed by the SBA would be more appropriate. The applicable size standard in this instance appears to be that of Wireless Telecommunications Carriers (except Satellite). This definition provides that a small entity is any such entity employing no more than 1,500 persons.¹⁷² The Commission's licensing database indicates that, as of January 20, 1999, of the 8,670 total MAS station authorizations, 8,410 authorizations were for private radio service, and of these, 1,433 were for private land mobile radio service.

1.4 GHz Band Licensees. The Commission conducted an auction of 64 1.4 GHz band licenses in the paired 1392-1395 MHz and 1432-1435 MHz bands, and in the unpaired 1390-1392 MHz band in 2007.¹⁷³ For these licenses, the Commission defined "small business" as an entity that, together with its affiliates and controlling interests, had average gross revenues not exceeding \$40 million for the preceding three years, and a "very small business" as an entity that, together with its affiliates and controlling interests, has had average annual gross revenues not exceeding \$15 million for the preceding three years.¹⁷⁴ Neither of the two winning bidders claimed small business status.¹⁷⁵

Incumbent 24 GHz Licensees. This analysis may affect incumbent licensees who were relocated to the 24 GHz band from the 18 GHz band, and applicants who wish to provide services in the 24 GHz band. For this service, the Commission uses the SBA small business size standard for the category "Wireless

¹⁶⁸ See *Amendment of the Commission's Rules Regarding Multiple Address Systems*, Report and Order, 15 FCC Rcd 11956, 12008, ¶ 123 (2000).

¹⁶⁹ *Id.*

¹⁷⁰ See *Alvarez Letter 1999*.

¹⁷¹ See "Multiple Address Systems Spectrum Auction Closes," Public Notice, 16 FCC Rcd 21011 (2001).

¹⁷² See 13 CFR § 121.201, NAICS code 517210.

¹⁷³ See "Auction of 1.4 GHz Band Licenses Scheduled for February 7, 2007," Public Notice, 21 FCC Rcd 12393 (WTB 2006); "Auction of 1.4 GHz Band Licenses Closes; Winning Bidders Announced for Auction No. 69," Public Notice, 22 FCC Rcd 4714 (2007) ("Auction No. 69 Closing PN").

¹⁷⁴ *Auction No. 69 Closing PN*, Attachment C.

¹⁷⁵ See *Auction No. 69 Closing PN*.

Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁷⁶ To gauge small business prevalence for these cable services we must, however, use the most current census data. Census data for 2007 shows that there were 1,383 firms that operated that year.¹⁷⁷ Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus, under this category and the associated small business size standard, the majority of firms can be considered small. The Commission notes that the Census’ use of the classifications “firms” does not track the number of “licenses”. The Commission believes that there are only two licensees in the 24 GHz band that were relocated from the 18 GHz band, Teligent¹⁷⁸ and TRW, Inc. It is our understanding that Teligent and its related companies have less than 1,500 employees, though this may change in the future. TRW is not a small entity. Thus, only one incumbent licensee in the 24 GHz band is a small business entity.

Future 24 GHz Licensees. With respect to new applicants for licenses in the 24 GHz band, for the purpose of determining eligibility for bidding credits, the Commission established three small business definitions. An “entrepreneur” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$40 million.¹⁷⁹ A “small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$15 million.¹⁸⁰ A “very small business” in the 24 GHz band is defined as an entity that, together with controlling interests and affiliates, has average gross revenues not exceeding \$3 million for the preceding three years.¹⁸¹ The SBA has approved these small business size standards.¹⁸² In a 2004 auction of 24 GHz licenses, three winning bidders won seven licenses.¹⁸³ Two of the winning bidders were very small businesses that won five licenses.

Broadband Radio Service and Educational Broadband Service. Broadband Radio Service systems, previously referred to as Multipoint Distribution Service (“MDS”) and Multichannel Multipoint Distribution Service (“MMDS”) systems, and “wireless cable,” transmit video programming to subscribers and provide two-way high speed data operations using the microwave frequencies of the Broadband Radio Service (“BRS”) and Educational Broadband Service (“EBS”) (previously referred to as the Instructional Television Fixed Service (“ITFS”).¹⁸⁴ In connection with the 1996 BRS auction, the

¹⁷⁶ 13 CFR § 121.201, NAICS code 517210.

¹⁷⁷ U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-lang=en.

¹⁷⁸ Teligent acquired the DEMS licenses of FirstMark, the only licensee other than TRW in the 24 GHz band whose license has been modified to require relocation to the 24 GHz band.

¹⁷⁹ *Amendments to Parts 1, 2, 87 and 101 of the Commission’s Rules to License Fixed Services at 24 GHz*, Report and Order, 15 FCC Rcd 16934, 16967 ¶ 77 (2000) (“24 GHz Report and Order”); see also 47 CFR § 101.538(a)(3).

¹⁸⁰ *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; see also 47 CFR § 101.538(a)(2).

¹⁸¹ *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; see also 47 CFR § 101.538(a)(1).

¹⁸² See Letter to Margaret W. Wiener, Deputy Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC, from Gary M. Jackson, Assistant Administrator, SBA (July 28, 2000).

¹⁸³ *Auction of 24 GHz Service Spectrum Auction Closes, Winning Bidders Announced for Auction 56, Down Payments Due August 16, 2004, Final Payments Due August 30, 2004, Ten-Day Petition to Deny Period*, Public Notice, 19 FCC Rcd 14738 (2004).

¹⁸⁴ *Amendment of Parts 21 and 74 of the Commission’s Rules with Regard to Filing Procedures in the Multipoint Distribution Service and in the Instructional Television Fixed Service and Implementation of Section 309(j) of the Communications Act—Competitive Bidding*, MM Docket No. 94-131, PP Docket No. 93-253, Report and Order, 10 FCC Rcd 9589, 9593 ¶ 7 (1995).

Commission established a small business size standard as an entity that had annual average gross revenues of no more than \$40 million in the previous three years.¹⁸⁵ The BRS auctions resulted in 67 successful bidders obtaining licensing opportunities for 493 Basic Trading Areas (“BTAs”). Of the 67 auction winners, 61 met the definition of a small business. BRS also includes licensees of stations authorized prior to the auction. At this time, we estimate that of the 61 small business BRS auction winners, 48 remain small business licensees. In addition to the 48 small businesses that hold BTA authorizations, there are approximately 392 incumbent BRS licensees that are considered small entities.¹⁸⁶ After adding the number of small business auction licensees to the number of incumbent licensees not already counted, we find that there are currently approximately 440 BRS licensees that are defined as small businesses under either the SBA or the Commission’s rules. In 2009, the Commission conducted Auction 86, the sale of 78 licenses in the BRS areas.¹⁸⁷ The Commission offered three levels of bidding credits: (i) a bidder with attributed average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years (small business) will receive a 15 percent discount on its winning bid; (ii) a bidder with attributed average annual gross revenues that exceed \$3 million and do not exceed \$15 million for the preceding three years (very small business) will receive a 25 percent discount on its winning bid; and (iii) a bidder with attributed average annual gross revenues that do not exceed \$3 million for the preceding three years (entrepreneur) will receive a 35 percent discount on its winning bid.¹⁸⁸ Auction 86 concluded in 2009 with the sale of 61 licenses.¹⁸⁹ Of the ten winning bidders, two bidders that claimed small business status won 4 licenses; one bidder that claimed very small business status won three licenses; and two bidders that claimed entrepreneur status won six licenses.

In addition, the SBA’s Cable Television Distribution Services small business size standard is applicable to EBS. There are presently 2,032 EBS licensees. All but 100 of these licenses are held by educational institutions. Educational institutions are included in this analysis as small entities.¹⁹⁰ Thus, we estimate that at least 1,932 licensees are small businesses. Since 2007, Cable Television Distribution Services have been defined within the broad economic census category of Wired Telecommunications Carriers; that category is defined as follows: “This industry comprises establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired telecommunications networks. Transmission facilities may be based on a single technology or a combination of technologies.”¹⁹¹ For these services, the Commission uses the SBA small business size standard for the category “Wireless Telecommunications Carriers (except satellite),” which is 1,500 or fewer employees.¹⁹² To gauge small

¹⁸⁵ 47 CFR § 21.961(b)(1).

¹⁸⁶ 47 U.S.C. § 309(j). Hundreds of stations were licensed to incumbent MDS licensees prior to implementation of Section 309(j) of the Communications Act of 1934, 47 U.S.C. § 309(j). For these pre-auction licenses, the applicable standard is SBA’s small business size standard of 1500 or fewer employees.

¹⁸⁷ *Auction of Broadband Radio Service (BRS) Licenses, Scheduled for October 27, 2009, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 86*, Public Notice, 24 FCC Rcd 8277 (2009).

¹⁸⁸ *Id.* at 8296.

¹⁸⁹ *Auction of Broadband Radio Service Licenses Closes, Winning Bidders Announced for Auction 86, Down Payments Due November 23, 2009, Final Payments Due December 8, 2009, Ten-Day Petition to Deny Period*, Public Notice, 24 FCC Rcd 13572 (2009).

¹⁹⁰ The term “small entity” within SBREFA applies to small organizations (nonprofits) and to small governmental jurisdictions (cities, counties, towns, townships, villages, school districts, and special districts with populations of less than 50,000). 5 U.S.C. §§ 601(4)–(6). We do not collect annual revenue data on EBS licensees.

¹⁹¹ U.S. Census Bureau, 2007 NAICS Definitions, 517110 Wired Telecommunications Carriers, (partial definition), <http://www.census.gov/naics/2007/def/ND517110.HTM#N517110>.

¹⁹² 13 CFR § 121.201, NAICS code 517210.

business prevalence for these cable services we must, however, use the most current census data. According to Census Bureau data for 2007, there were a total of 955 firms in this previous category that operated for the entire year.¹⁹³ Of this total, 939 firms employed 999 or fewer employees, and 16 firms employed 1,000 employees or more.¹⁹⁴ Thus, the majority of these firms can be considered small.

Television Broadcasting. This Economic Census category “comprises establishments primarily engaged in broadcasting images together with sound. These establishments operate television broadcasting studios and facilities for the programming and transmission of programs to the public.”¹⁹⁵ The SBA has created the following small business size standard for Television Broadcasting firms: those having \$14 million or less in annual receipts.¹⁹⁶ The Commission has estimated the number of licensed commercial television stations to be 1,387.¹⁹⁷ In addition, according to Commission staff review of the BIA Advisory Services, LLC’s *Media Access Pro Television Database* on March 28, 2012, about 950 of an estimated 1,300 commercial television stations (or approximately 73 percent) had revenues of \$14 million or less.¹⁹⁸ We therefore estimate that the majority of commercial television broadcasters are small entities.

We note, however, that in assessing whether a business concern qualifies as small under the above definition, business (control) affiliations¹⁹⁹ must be included. Our estimate, therefore, likely overstates the number of small entities that might be affected by our action because the revenue figure on which it is based does not include or aggregate revenues from affiliated companies. In addition, an element of the definition of “small business” is that the entity not be dominant in its field of operation. We are unable at this time to define or quantify the criteria that would establish whether a specific television station is dominant in its field of operation. Accordingly, the estimate of small businesses to which rules may apply does not exclude any television station from the definition of a small business on this basis and is therefore possibly over-inclusive to that extent.

In addition, the Commission has estimated the number of licensed noncommercial educational (NCE) television stations to be 396.²⁰⁰ These stations are non-profit, and therefore considered to be small entities.²⁰¹

In addition, there are also 2,528 low power television stations, including Class A stations (LPTV).²⁰² Given the nature of these services, we will presume that all LPTV licensees qualify as small entities under the above SBA small business size standard.

¹⁹³ U.S. Census Bureau, 2007 Economic Census, Subject Series: Information, Table 5, Employment Size of Firms for the United States: 2007, NAICS code 5171102 (issued November 2010).

¹⁹⁴ *Id.*

¹⁹⁵ U.S. Census Bureau, 2007 NAICS Definitions, “515120 Television Broadcasting” (partial definition); <http://www.census.gov/naics/2007/def/ND515120.HTM#N515120>.

¹⁹⁶ 13 CFR § 121.201, NAICS code 515120 (updated for inflation in 2010).

¹⁹⁷ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-311837A1.pdf.

¹⁹⁸ We recognize that BIA’s estimate differs slightly from the FCC total given.

¹⁹⁹ “[Business concerns] are affiliates of each other when one concern controls or has the power to control the other or a third party or parties controls or has to power to control both.” 13 CFR § 21.103(a)(1).

²⁰⁰ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

²⁰¹ See generally 5 U.S.C. §§ 601(4), (6).

²⁰² See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

Radio Broadcasting. This Economic Census category “comprises establishments primarily engaged in broadcasting aural programs by radio to the public. Programming may originate in their own studio, from an affiliated network, or from external sources.”²⁰³ The SBA has established a small business size standard for this category, which is: such firms having \$7 million or less in annual receipts.²⁰⁴ According to Commission staff review of BIA Advisory Services, LLC’s *Media Access Pro Radio Database* on March 28, 2012, about 10,759 (97%) of 11,102 commercial radio stations had revenues of \$7 million or less. Therefore, the majority of such entities are small entities.

We note, however, that in assessing whether a business concern qualifies as small under the above size standard, business affiliations must be included.²⁰⁵ In addition, to be determined to be a “small business,” the entity may not be dominant in its field of operation.²⁰⁶ We note that it is difficult at times to assess these criteria in the context of media entities, and our estimate of small businesses may therefore be over-inclusive.

Auxiliary, Special Broadcast and Other Program Distribution Services. This service involves a variety of transmitters, generally used to relay broadcast programming to the public (through translator and booster stations) or within the program distribution chain (from a remote news gathering unit back to the station). The Commission has not developed a definition of small entities applicable to broadcast auxiliary licensees. The applicable definitions of small entities are those, noted previously, under the SBA rules applicable to radio broadcasting stations and television broadcasting stations.²⁰⁷

The Commission estimates that there are approximately 6,099 FM translators and boosters.²⁰⁸ The Commission does not collect financial information on any broadcast facility, and the Department of Commerce does not collect financial information on these auxiliary broadcast facilities. We believe that most, if not all, of these auxiliary facilities could be classified as small businesses by themselves. We also recognize that most commercial translators and boosters are owned by a parent station which, in some cases, would be covered by the revenue definition of small business entity discussed above. These stations would likely have annual revenues that exceed the SBA maximum to be designated as a small business (\$7.0 million for a radio station or \$14.0 million for a TV station). Furthermore, they do not meet the Small Business Act’s definition of a “small business concern” because they are not independently owned and operated.²⁰⁹

Multichannel Video Distribution and Data Service. MVDDS is a terrestrial fixed microwave service operating in the 12.2-12.7 GHz band. The Commission adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits. It defines a very small business as an entity with average annual gross revenues not exceeding \$3 million

²⁰³ U.S. Census Bureau, 2007 NAICS Definitions, “515112 Radio Stations”; <http://www.census.gov/naics/2007/def/ND515112.HTM#N515112>.

²⁰⁴ 13 CFR § 121.201, NAICS code 515112 (updated for inflation in 2010).

²⁰⁵ “Concerns and entities are affiliates of each other when one controls or has the power to control the other, or a third party or parties controls or has the power to control both. It does not matter whether control is exercised, so long as the power to control exists.” 13 CFR § 121.103(a)(1) (an SBA regulation).

²⁰⁶ 13 CFR § 121.102(b) (an SBA regulation).

²⁰⁷ 13 CFR 121.201, NAICS codes 515112 and 515120.

²⁰⁸ See *FCC News Release*, “Broadcast Station Totals as of December 31, 2011,” dated January 6, 2012; http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0106/DOC-311837A1.pdf.

²⁰⁹ See 15 U.S.C. § 632.

for the preceding three years; a small business as an entity with average annual gross revenues not exceeding \$15 million for the preceding three years; and an entrepreneur as an entity with average annual gross revenues not exceeding \$40 million for the preceding three years.²¹⁰ These definitions were approved by the SBA.²¹¹ On January 27, 2004, the Commission completed an auction of 214 MVDDS licenses (Auction No. 53). In this auction, ten winning bidders won a total of 192 MVDDS licenses.²¹² Eight of the ten winning bidders claimed small business status and won 144 of the licenses. The Commission also held an auction of MVDDS licenses on December 7, 2005 (Auction 63). Of the three winning bidders who won 22 licenses, two winning bidders, winning 21 of the licenses, claimed small business status.²¹³

Amateur Radio Service. These licensees are held by individuals in a noncommercial capacity; these licensees are not small entities.

Personal Radio Services. Personal radio services provide short-range, low power radio for personal communications, radio signaling, and business communications not provided for in other services. The Personal Radio Services include spectrum licensed under Part 95 of our rules.²¹⁴ These services include Citizen Band Radio Service (“CB”), General Mobile Radio Service (“GMRS”), Radio Control Radio Service (“R/C”), Family Radio Service (“FRS”), Wireless Medical Telemetry Service (“WMTS”), Medical Implant Communications Service (“MICS”), Low Power Radio Service (“LPRS”), and Multi-Use Radio Service (“MURS”).²¹⁵ There are a variety of methods used to license the spectrum in these rule parts, from licensing by rule, to conditioning operation on successful completion of a required test, to site-based licensing, to geographic area licensing. Under the RFA, the Commission is required to make a determination of which small entities are directly affected by the rules being proposed. Since all such entities are wireless, we apply the definition of Wireless Telecommunications Carriers (except Satellite), pursuant to which a small entity is defined as employing 1,500 or fewer persons.²¹⁶ Many of the licensees in these services are individuals, and thus are not small entities. In addition, due to the mostly unlicensed and shared nature of the spectrum utilized in many of these services, the Commission lacks direct information upon which to base an estimation of the number of small entities under an SBA definition that might be directly affected by our proposed actions.

²¹⁰ *Amendment of Parts 2 and 25 of the Commission’s Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range; Amendment of the Commission’s Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licenses and their Affiliates; and Applications of Broadwave USA, PDC Broadband Corporation, and Satellite Receivers, Ltd. to provide A Fixed Service in the 12.2-12.7 GHz Band*, ET Docket No. 98-206, Memorandum Opinion and Order and Second Report and Order, 17 FCC Rcd 9614, 9711, ¶ 252 (2002).

²¹¹ See Letter from Hector V. Barreto, Administrator, U.S. Small Business Administration, to Margaret W. Wiener, Chief, Auctions and Industry Analysis Division, WTB, FCC (Feb.13, 2002).

²¹² See “Multichannel Video Distribution and Data Service Auction Closes,” Public Notice, 19 FCC Rcd 1834 (2004).

²¹³ See “Auction of Multichannel Video Distribution and Data Service Licenses Closes; Winning Bidders Announced for Auction No. 63,” Public Notice, 20 FCC Rcd 19807 (2005).

²¹⁴ 47 CFR part 90.

²¹⁵ The Citizens Band Radio Service, General Mobile Radio Service, Radio Control Radio Service, Family Radio Service, Wireless Medical Telemetry Service, Medical Implant Communications Service, Low Power Radio Service, and Multi-Use Radio Service are governed by subpart D, subpart A, subpart C, subpart B, subpart H, subpart I, subpart G, and subpart J, respectively, of part 95 of the Commission’s rules. See generally 47 CFR part 95.

²¹⁶ 13 CFR § 121.201, NAICS Code 517210.

Public Safety Radio Services. Public Safety radio services include police, fire, local government, forestry conservation, highway maintenance, and emergency medical services.²¹⁷ There are a total of approximately 127,540 licensees in these services. Governmental entities²¹⁸ as well as private businesses comprise the licensees for these services. All governmental entities with populations of less than 50,000 fall within the definition of a small entity.²¹⁹

IMTS Resale Carriers. Providers of IMTS resale services are common carriers that purchase IMTS from other carriers and resell it to their own customers. Under that size standard, such a business is small if it has 1,500 or fewer employees.²²⁰ Census data for 2007 show that 1,523 firms provided resale services during that year. Of that number, 1,522 operated with fewer than 1000 employees and one operated with more than 1,000.²²¹ Thus under this category and the associated small business size standard, the majority of these local resellers can be considered small entities. According to Commission data, 213 carriers have reported that they are engaged in the provision of local resale services.²²² Of these, an estimated 211 have 1,500 or fewer employees and two have more than 1,500 employees.²²³ Consequently, the Commission estimates that the majority of IMTS resellers are small entities that may be affected by our proposed actions.

Wireless Carriers and Service Providers. Included among the providers of IMTS resale are a number of wireless carriers that also provide wireless telephony services domestically. The Commission classifies these entities as providers of Commercial Mobile Radio Services (CMRS). At present, most, if not all, providers of CMRS that offer IMTS provide such service by purchasing IMTS from other carriers to resell it to their customers. The Commission has not developed a size standard specifically for CMRS providers that offer resale IMTS. Such entities would fall within the larger category of wireless carriers and service providers. For those services subject to auctions, the Commission notes that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not

²¹⁷ With the exception of the special emergency service, these services are governed by subpart B of part 90 of the Commission's Rules, 47 CFR §§ 90.15-90.27. The police service includes approximately 27,000 licensees that serve state, county, and municipal enforcement through telephony (voice), telegraphy (code) and teletype and facsimile (printed material). The fire radio service includes approximately 23,000 licensees comprised of private volunteer or professional fire companies as well as units under governmental control. The local government service is presently comprised of approximately 41,000 licensees that are state, county, or municipal entities that use the radio for official purposes not covered by other public safety services. There are approximately 7,000 licensees within the forestry service which is comprised of licensees from state departments of conservation and private forest organizations who set up communications networks among fire lookout towers and ground crews. The approximately 9,000 state and local governments are licensed for highway maintenance service to provide emergency and routine communications to aid other public safety services to keep main roads safe for vehicular traffic. The approximately 1,000 licensees in the Emergency Medical Radio Service ("EMRS") use the 39 channels allocated to this service for emergency medical service communications related to the delivery of emergency medical treatment. 47 CFR §§ 90.15-90.27. The approximately 20,000 licensees in the special emergency service include medical services, rescue organizations, veterinarians, handicapped persons, disaster relief organizations, school buses, beach patrols, establishments in isolated areas, communications standby facilities, and emergency repair of public communications facilities. 47 CFR §§ 90.33-90.55.

²¹⁸ 47 CFR § 1.1162.

²¹⁹ 5 U.S.C. § 601(5).

²²⁰ 13 CFR § 121.201, NAICS code 517911.

²²¹ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=800&-ds_name=EC0751SSSZ5&-lang=en.

²²² See *Trends in Telephone Service*, at Tbl. 5.3.

²²³ *Id.*

generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements

The proposals being made in this *Notice*, may require additional analysis and mitigation activities regarding compliance with our RF exposure limits for certain facilities, operations, and transmitters, such as some wireless base stations, particularly those on rooftops, and some antennas at multiple transmitter sites. In other cases, current analytical requirements are being relaxed.

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

The RFA requires an agency to describe any significant, specifically small business, alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): “(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for such small entities; (3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.”²²⁴ In this proceeding, our proposals are consistent with (2), in that our goal is making our RF rules more consistent and clarifying certain areas that have created confusion in the past. In addition, due to our revisions in our policy on categorical exclusions, we are providing exemptions from RF exposure routine evaluation for many small entities that should reduce the overall impact on small entities (see number 4 above).

F. Federal Rules that May Duplicate, Overlap, or Conflict with the Proposed Rule

None.

²²⁴ 5 U.S.C. § 603(c).

APPENDIX D

Final Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980, as amended (RFA),¹ an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Further Notice of Proposed Rule Making* (FNPRM) in ET Docket 03-137.² The Commission sought written public comment on the proposals in the FNPRM, including comment on the IRFA. This Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.³

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

The National Environmental Policy Act of 1969 (NEPA) requires agencies of the Federal Government to evaluate the effects of their actions on the quality of the human environment.⁴ To meet its responsibilities under NEPA, the Commission has adopted requirements for evaluating the environmental impact of its actions.⁵ One of several environmental factors addressed by these requirements is human exposure to radiofrequency (RF) energy emitted by FCC-regulated transmitters, facilities, and devices.⁶

The Second Report and Order amends Parts 1, 2 and 95 of our rules relating to the compliance of FCC-regulated transmitters, facilities, and devices with the guidelines for human exposure to radiofrequency (RF) energy adopted by the Commission in 2013. Specifically, we are making certain revisions in the rules that we believe will result in more efficient, practical, and consistent application of compliance procedures in three parts. First, the Second Report and Order addresses the exemptions from the RF exposure routine evaluation requirement, identifying broad criteria that apply to single and multiple RF sources based on power, distance, and frequency, irrespective of service classifications. The Office of Engineering and Technology (OET),⁷ will offer more detailed case-specific guidance as needed through the Knowledge Database (KDB), as well as through technical bulletins and supplements, such as OET Bulletin 65.⁸

¹ See 5 U.S.C. § 603. The RFA, see 5 U.S.C. §§ 601-612, has been amended by the Contract with America Advancement Act of 1996, Public Law 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

² *Proposed Changes in the Commission's Rules Regarding Human Exposure to Radiofrequency Electromagnetic Fields*, ET Docket No. 03-137, *First Report and Order, Further Notice of Proposed Rulemaking, and Notice of Inquiry*, 28 FCC Rcd 3498, 3533-69, paras. 108-204 (2013) (*2013 RF Order and Notice*).

³ See 5 U.S.C. § 604.

⁴ National Environmental Policy Act of 1969, as amended, 42 U.S.C. §§ 4321-35.

⁵ See 47 CFR pt. 1, subpt. I.

⁶ See, e.g., 47 CFR § 1.1310; *2013 Order and Notice*, 28 FCC Rcd 3498, 3505-32, paras. 14-107 (2013).

⁷ OET has developed a substantial body of guidance that is available via public notices, frequently asked questions (FAQ's), and specific process guidance all of which is compiled in our online Knowledge Database (KDB). See <https://apps.fcc.gov/oetcf/kdb/>. Equipment authorization topics that relate to new services and devices authorized by the Commission are often addressed in the KDB. This includes, for example, simple answers to questions, guidance on how to file for authorization of new types of devices, and guidance on how to conduct compliance testing. The staff guidance provided in the KDB is intended to assist the public in following Commission requirements and is non-binding.

⁸ FCC Office of Engineering and Technology, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*, OET Bulletin 65, Edition 97-01 (1997) (OET Bulletin 65). OET Bulletin 65 provides guidance in determining whether proposed or existing transmitting facilities or operations comply with FCC rules limiting human exposure to RF energy. *Id.* at 1. Supplements A and B to OET Bulletin 65 provide specialized guidance for specific services – broadcasting and amateur radio, respectively – in their compliance determinations.

Second, the Second Report and Order clarifies the calculation or measurement methodologies that should be used, in cases where no exemption applies, to determine potential RF exposure levels in the RF exposure evaluation process. The third and final section of the Second Report and Order addresses post-evaluation mitigation procedures, like access, signage, and training, to ensure that persons – both the general public and trained personnel – are not exposed to RF emissions in excess of our established exposure limits. The new rules clarify the obligations of licensees to provide safety training to workers and to supervise any members of the general public (including untrained workers) who are permitted to enter a restricted area.

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

No public comments were filed in response to the IRFA in this proceeding. In addition, no comments were submitted concerning small business issues.

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

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.⁹ The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

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

The RFA directs agencies to provide a description of, and, where feasible, an estimate of, the number of small entities that may be affected by the rules adopted herein.¹⁰ The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”¹¹ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.¹² 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.¹³

Small Businesses, Small Organizations, and Small Governmental Jurisdictions. Our action may, over time, affect small entities that are not easily categorized at present. We therefore describe here, at the outset, three comprehensive, statutory small entity size standards.¹⁴ First, nationwide, there are a total of approximately 27.5 million small businesses, according to the SBA.¹⁵ In addition, a “small organization”

⁹ 5 U.S.C. § 604(a)(3).

¹⁰ 5 U.S.C. § 603(b)(3).

¹¹ 5 U.S.C. § 601(6).

¹² 5 U.S.C. § 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.”

¹³ 15 U.S.C. § 632.

¹⁴ See 5 U.S.C. § 601(3)–(6).

¹⁵ See SBA, Office of Advocacy, “Frequently Asked Questions,” web.sba.gov/faqs (last visited May 6, 2011; figures are from 2009).

is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”¹⁶ Nationwide, as of 2007, there were approximately 1,621,315 small organizations.¹⁷ Finally, the term “small governmental jurisdiction” is defined generally as “governments of cities, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”¹⁸ Census Bureau data for 2011 indicate that there were 89,476 local governmental jurisdictions in the United States.¹⁹ We estimate that, of this total, as many as 88,506 entities may qualify as “small governmental jurisdictions.”²⁰ Thus, we estimate that most governmental jurisdictions are small.

Experimental Radio Service (Other Than Broadcast). The majority of experimental licenses are issued to companies such as Motorola and Department of Defense contractors such as Northrop, Lockheed and Martin Marietta. Businesses such as these may have as many as 200 licenses at one time. The majority of these applications are from entities such as these. Given this fact, the remaining 30 percent of applications, we assume, for purposes of our evaluations and conclusions in this FRFA, will be awarded to small entities, as that term is defined by the SBA.

The Commission processes approximately 1,000 applications a year for experimental radio operations. About half or 500 of these are renewals and the other half are for new licenses. We do not have adequate information to predict precisely how many of these applications will be impacted by our rule revisions. However, based on the above figures we estimate that as many as 300 of these applications could be from small entities and potentially could be impacted.

International Broadcast Stations. Commission records show that there are 19 international high frequency broadcast station authorizations. We do not request nor collect annual revenue information and are unable to estimate the number of international high frequency broadcast stations that would constitute a small business under the SBA definition. Since all international broadcast stations operate using relatively high power levels, it is likely that they could all be impacted by our rule revisions.

Satellite Telecommunications. Two economic census categories address the satellite industry. The first category has a small business size standard of \$15 million or less in average annual receipts, under SBA rules.²¹ The second has a size standard of \$25 million or less in annual receipts.²²

¹⁶ 5 U.S.C. § 601(4).

¹⁷ INDEPENDENT SECTOR, THE NEW NONPROFIT ALMANAC & DESK REFERENCE (2010).

¹⁸ 5 U.S.C. § 601(5).

¹⁹ U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2011, Table 427 (2007)

²⁰The 2007 U.S. Census data for small governmental organizations indicate that there were 89,476 “Local Governments” in 2007. (U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES 2011, Table 428.) The criterion by which the size of such local governments is determined to be small is a population of 50,000. However, since the Census Bureau does not specifically apply that criterion, it cannot be determined with precision how many of such local governmental organizations is small. Nonetheless, the inference seems reasonable that substantial number of these governmental organizations has a population of less than 50,000. To look at Table 428 in conjunction with a related set of data in Table 429 in the Census’s Statistical Abstract of the U.S., that inference is further supported by the fact that in both Tables, many entities that may well be small are included in the 89,476 local governmental organizations, e.g. county, municipal, township and town, school district and special district entities. Measured by a criterion of a population of 50,000 many specific sub-entities in this category seem more likely than larger county-level governmental organizations to have small populations. Accordingly, of the 89,746 small governmental organizations identified in the 2007 Census, the Commission estimates that a substantial majority is small. 20 13 CFR § 121.201, NAICS code 517110.

²¹ 13 CFR § 121.201, NAICS code 517410.

²² 13 CFR § 121.201, NAICS code 517919.

The category of Satellite Telecommunications “comprises establishments 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.”²³ Census Bureau data for 2007 show that 512 Satellite Telecommunications firms that operated for that entire year.²⁴ Of this total, 464 firms had annual receipts of under \$10 million, and 18 firms had receipts of \$10 million to \$24,999,999.²⁵ Consequently, the Commission estimates that the majority of Satellite Telecommunications firms are small entities that might be affected by our actions.

The second category, i.e., “All Other Telecommunications” comprises “establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.”²⁶ For this category, Census Bureau data for 2007 shows that there were a total of 2,383 firms that operated for the entire year.²⁷ Of this total, 2,347 firms had annual receipts of under \$25 million and 12 firms had annual receipts of \$25 million to \$49,999,999.²⁸ Consequently, the Commission estimates that the majority of All Other Telecommunications firms are small entities that might be affected by our actions.

Fixed Satellite Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Transmit/Receive Earth Stations. We do not request or collect annual revenue information, and are unable to estimate the number of the earth stations that would constitute small businesses under the SBA definition. However, the majority of these stations could be impacted by our revised rules.

Fixed Satellite Small Transmit/Receive Earth Stations. There are approximately 4,303 earth station authorizations, a portion of which are Fixed Satellite Small Transmit/Receive Earth Stations. We do not request or collect annual revenue information, and are unable to estimate the number of fixed small satellite transmit/receive earth stations that would constitute small businesses under the SBA definition. However, the majority of these stations could be impacted by our revised rules.

Fixed Satellite Very Small Aperture Terminal (VSAT) Systems. These stations operate on a primary basis, and frequency coordination with terrestrial microwave systems is not required. Thus, a single “blanket” application may be filed for a specified number of small antennas and one or more hub stations. There are 492 current VSAT System authorizations. We do not request or collect annual revenue information, and are unable to estimate the number of VSAT systems that would constitute small

²³ U.S. Census Bureau, 2007 NAICS Definitions, 517410 Satellite Telecommunications.

²⁴ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

²⁵ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

²⁶ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517919&search=2007%20NAICS%20Search>.

²⁷ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

²⁸ http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-skip=900&-ds_name=EC0751SSSZ4&-lang=en.

businesses under the SBA definition. However, it is expected that many of these stations could be impacted by our revised rules.

Mobile Satellite Earth Stations. There are 19 licensees. We do not request or collect annual revenue information, and are unable to estimate the number of mobile satellite earth stations that would constitute small businesses under the SBA definition. However, it is expected that many of these stations could be impacted by our revised rules.

Wireless Telecommunications Carriers (except Satellite). This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services.²⁹ The appropriate size standard under SBA rules is for the category Wireless Telecommunications Carriers. The size standard for that category is that a business is small if it has 1,500 or fewer employees.³⁰ Under the present and prior categories, the SBA has deemed a wireless business to be small if it has 1,500 or fewer employees.³¹ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.³² Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.³³ Thus under this category and the associated small business size standard, the Commission estimates that the majority of wireless telecommunications carriers(except satellite) are small entities that may be affected by our proposed actions.³⁴

Licenses Assigned by Auctions. Initially, we note that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

Paging Services. Neither the SBA nor the FCC has developed a definition applicable exclusively to paging services. However, a variety of paging services is now categorized under Wireless Telecommunications Carriers (except satellite).³⁵ This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services. Illustrative examples in the paging context include paging services, except satellite; two-way paging communications carriers, except satellite; and radio paging services communications carriers. The

²⁹ <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517210&search=2007%20NAICS%20Search>.

³⁰ 13 CFR § 121.201, NAICS code 517210.

³¹ 13 CFR § 121.201, NAICS code 517210. The now-superseded, pre-2007 CFR citations were 13 CFR § 121.201, NAICS codes 517211 and 517212 (referring to the 2002 NAICS).

³² U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

³³ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

³⁴ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-_skip=600&-ds_name=EC0751SSSZ5&-_lang=en.

³⁵ U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”; <http://www.census.gov/naics/2007/def/ND517210.HTM#N517210>.

SBA has deemed a paging service in this category to be small if it has 1,500 or fewer employees.³⁶ For this category, census data for 2007 show that there were 1,383 firms that operated for the entire year.³⁷ Of this total, 1,368 firms had employment of 999 or fewer employees and 15 had employment of 1000 employees or more.³⁸ Thus under this category and the associated small business size standard, the Commission estimates that the majority of paging services in the category of wireless telecommunications carriers(except satellite) are small entities that may be affected by our actions.³⁹

In addition, in the Paging Second Report and Order, the Commission adopted a size standard for “small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.⁴⁰ A small business is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.⁴¹ The SBA has approved this definition.⁴² An initial auction of Metropolitan Economic Area (“MEA”) licenses was conducted in the year 2000. Of the 2,499 licenses auctioned, 985 were sold.⁴³ Fifty-seven companies claiming small business status won 440 licenses.⁴⁴ A subsequent auction of MEA and Economic Area (“EA”) licenses was held in the year 2001. Of the 15,514 licenses auctioned, 5,323 were sold.⁴⁵ One hundred thirty-two companies claiming small business status purchased 3,724 licenses. A third auction, consisting of 8,874 licenses in each of 175 EAs and 1,328 licenses in all but three of the 51 MEAs, was held in 2003. Seventy-seven bidders claiming small or very small business status won 2,093 licenses.⁴⁶ A fourth auction of 9,603 lower and upper band paging licenses was held in the year 2010. 29 bidders claiming small or very small business status won 3,016 licenses.

2.3 GHz Wireless Communications Services. This service can be used for fixed, mobile, radiolocation, and digital audio broadcasting satellite uses. The Commission defined “small business” for the wireless communications services (“WCS”) auction as an entity with average gross revenues of \$40 million for

³⁶ U.S. Census Bureau, 2007 NAICS Definitions, “517210 Wireless Telecommunications Categories (Except Satellite)”

³⁷ U.S. Census Bureau, Subject Series: Information, Table 5, “Establishment and Firm Size: Employment Size of Firms for the United States: 2007 NAICS Code 517210” (issued Nov. 2010).

³⁸ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

³⁹ See http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=600&-ds_name=EC0751SSSZ5&-lang=en.

⁴⁰ *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Second Report and Order, 12 FCC Rcd 2732, 2811-2812, paras. 178-181 (“*Paging Second Report and Order*”); see also *Revision of Part 22 and Part 90 of the Commission’s Rules to Facilitate Future Development of Paging Systems*, Memorandum Opinion and Order on Reconsideration, 14 FCC Rcd 10030, 10085-10088, ¶¶ 98-107 (1999).

⁴¹ *Paging Second Report and Order*, 12 FCC Rcd at 2811, ¶ 179.

⁴² See Letter from Aida Alvarez, Administrator, SBA, to Amy Zoslov, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau (“WTB”), FCC (Dec. 2, 1998) (“*Alvarez Letter 1998*”).

⁴³ See “*929 and 931 MHz Paging Auction Closes*,” Public Notice, 15 FCC Rcd 4858 (WTB 2000).

⁴⁴ See *id.*

⁴⁵ See “*Lower and Upper Paging Band Auction Closes*,” Public Notice, 16 FCC Rcd 21821 (WTB 2002).

⁴⁶ See “*Lower and Upper Paging Bands Auction Closes*,” Public Notice, 18 FCC Rcd 11154 (WTB 2003). The current number of small or very small business entities that hold wireless licenses may differ significantly from the number of such entities that won in spectrum auctions due to assignments and transfers of licenses in the secondary market over time. In addition, some of the same small business entities may have won licenses in more than one auction.

each of the three preceding years, and a “very small business” as an entity with average gross revenues of \$15 million for each of the three preceding years.⁴⁷ The SBA approved these definitions.⁴⁸ The Commission conducted an auction of geographic area licenses in the WCS service in 1997. In the auction, seven bidders that qualified as very small business entities won 31 licenses, and one bidder that qualified as a small business entity won a license.

1670-1675 MHz Services. This service can be used for fixed and mobile uses, except aeronautical mobile.⁴⁹ An auction for one license in the 1670-1675 MHz band was conducted in 2003. The Commission defined a “small business” as an entity with attributable average annual gross revenues of not more than \$40 million for the preceding three years, which would thus be eligible for a 15 percent discount on its winning bid for the 1670-1675 MHz band license. Further, the Commission defined a “very small business” as an entity with attributable average annual gross revenues of not more than \$15 million for the preceding three years, which would thus be eligible to receive a 25 percent discount on its winning bid for the 1670-1675 MHz band license. The winning bidder was not a small entity.

Wireless Telephony. Wireless telephony includes cellular, personal communications services, and specialized mobile radio telephony carriers. As noted, the SBA has developed a small business size standard for Wireless Telecommunications Carriers (except Satellite).⁵⁰ Under the SBA small business size standard, a business is small if it has 1,500 or fewer employees.⁵¹ Census data for 2007 shows that there were 1,383 firms that operated that year.⁵² Of those 1,383, 1,368 had fewer than 100 employees, and 15 firms had more than 100 employees. Thus, under this category and the associated small business size standard, the majority of firms can be considered small. According to Trends in Telephone Service data, 434 carriers reported that they were engaged in wireless telephony.⁵³ Of these, an estimated 222 have 1,500 or fewer employees and 212 have more than 1,500 employees.⁵⁴ Therefore, approximately half of these entities can be considered small. Similarly, according to Commission data, 413 carriers reported that they were engaged in the provision of wireless telephony, including cellular service, Personal Communications Service (PCS), and Specialized Mobile Radio (SMR) Telephony services.⁵⁵ Of these, an estimated 261 have 1,500 or fewer employees and 152 have more than 1,500 employees.⁵⁶ Consequently, the Commission estimates that approximately half or more of these firms can be considered small. Thus, using available data, we estimate that the majority of wireless firms can be considered small.

Broadband Personal Communications Service. The broadband personal communications services (PCS) spectrum is divided into six frequency blocks designated A through F, and the Commission has

⁴⁷ *Amendment of the Commission’s Rules to Establish Part 27, the Wireless Communications Service (WCS)*, Report and Order, 12 FCC Rcd 10785, 10879, para. 194 (1997).

⁴⁸ *See Alvarez Letter 1998*.

⁴⁹ 47 CFR § 2.106; *see generally* 47 CFR §§ 27.1–.70.

⁵⁰ 13 CFR § 121.201, NAICS code 517312.

⁵¹ *Id.*

⁵² U.S. Census Bureau, 2007 Economic Census, Sector 51, 2007 NAICS code 517210 (rel. Oct. 20, 2009), http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-fds_name=EC0700A1&-skip=700&-ds_name=EC0751SSSZ5&-lang=en.

⁵³ *Trends in Telephone Service*, at Tbl. 5.3.

⁵⁴ *Id.*

⁵⁵ *See Trends in Telephone Service*, at Tbl. 5.3.

⁵⁶ *See id.*

held auctions for each block. The Commission initially defined a “small business” for C- and F-Block licenses as an entity that has average gross revenues of \$40 million or less in the three previous years.⁵⁷ For F-Block licenses, an additional small business size standard for “very small business” was added and is defined as an entity that, together with its affiliates, has average gross revenues of not more than \$15 million for the preceding three years.⁵⁸ These small business size standards, in the context of broadband PCS auctions, have been approved by the SBA.⁵⁹ No small businesses within the SBA-approved small business size standards bid successfully for licenses in Blocks A and B. There were 90 winning bidders that claimed small business status in the first two C-Block auctions. A total of 93 bidders that claimed small and very small business status won approximately 40 percent of the 1,479 licenses in the first auction for the D, E, and F Blocks.⁶⁰ On April 15, 1999, the Commission completed the re-auction of 347 C-, D-, E-, and F-Block licenses in Auction No. 22.⁶¹ Of the 57 winning bidders in that auction, 48 claimed small business status and won 277 licenses.

On January 26, 2001, the Commission completed the auction of 422 C and F Block Broadband PCS licenses in Auction No. 35. Of the 35 winning bidders in that auction, 29 claimed small business status.⁶² Subsequent events concerning Auction 35, including judicial and agency determinations, resulted in a total of 163 C and F Block licenses being available for grant. On February 15, 2005, the Commission completed an auction of 242 C-, D-, E-, and F-Block licenses in Auction No. 58. Of the 24 winning bidders in that auction, 16 claimed small business status and won 156 licenses.⁶³ On May 21, 2007, the Commission completed an auction of 33 licenses in the A, C, and F Blocks in Auction No. 71.⁶⁴ Of the 14 winning bidders in that auction, six claimed small business status and won 18 licenses.⁶⁵ On August 20, 2008, the Commission completed the auction of 20 C-, D-, E-, and F-Block Broadband PCS licenses in Auction No. 78.⁶⁶ Of the eight winning bidders for Broadband PCS licenses in that auction, six claimed small business status and won 14 licenses.⁶⁷

⁵⁷ See *Amendment of Parts 20 and 24 of the Commission’s Rules – Broadband PCS Competitive Bidding and the Commercial Mobile Radio Service Spectrum Cap; Amendment of the Commission’s Cellular/PCS Cross-Ownership Rule*, WT Docket No. 96-59, GN Docket No. 90-314, Report and Order, 11 FCC Rcd 7824, 7850–52, paras. 57–60 (1996) (“*PCS Report and Order*”); see also 47 CFR § 24.720(b).

⁵⁸ See *PCS Report and Order*, 11 FCC Rcd at 7852, para. 60.

⁵⁹ See *Alvarez Letter 1998*.

⁶⁰ See *Broadband PCS, D, E and F Block Auction Closes*, Public Notice, Doc. No. 89838 (Jan. 14, 1997).

⁶¹ See *C, D, E, and F Block Broadband PCS Auction Closes*, Public Notice, 14 FCC Rcd 6688 (WTB 1999). Before Auction No. 22, the Commission established a very small standard for the C Block to match the standard used for F Block. *Amendment of the Commission’s Rules Regarding Installment Payment Financing for Personal Communications Services (PCS) Licensees*, WT Docket No. 97-82, Fourth Report and Order, 13 FCC Rcd 15743, 15768, para. 46 (1998).

⁶² See *C and F Block Broadband PCS Auction Closes; Winning Bidders Announced*, Public Notice, 16 FCC Rcd 2339 (2001).

⁶³ See *Broadband PCS Spectrum Auction Closes; Winning Bidders Announced for Auction No. 58*, Public Notice, 20 FCC Rcd 3703 (2005).

⁶⁴ See *Auction of Broadband PCS Spectrum Licenses Closes; Winning Bidders Announced for Auction No. 71*, Public Notice, 22 FCC Rcd 9247 (2007).

⁶⁵ *Id.*

⁶⁶ See *Auction of AWS-1 and Broadband PCS Licenses Closes; Winning Bidders Announced for Auction 78*, Public Notice, 23 FCC Rcd 12749 (WTB 2008).

⁶⁷ *Id.*

Advanced Wireless Services. In 2006, the Commission conducted its first auction of Advanced Wireless Services licenses in the 1710-1755 MHz and 2110-2155 MHz bands (“AWS-1”), designated as Auction 66.⁶⁸ For the AWS-1 bands, the Commission has defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million, and a “very small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$15 million.⁶⁹ In 2006, the Commission conducted its first auction of AWS-1 licenses.⁷⁰ In that initial AWS-1 auction, 31 winning bidders identified themselves as very small businesses won 142 licenses.⁷¹ Twenty-six of the winning bidders identified themselves as small businesses and won 73 licenses.⁷² In a subsequent 2008 auction, the Commission offered 35 AWS-1 licenses.⁷³ Four winning bidders identified themselves as very small businesses, and three of the winning bidders identifying themselves as a small businesses won five AWS-1 licenses.⁷⁴

Narrowband Personal Communications Services. In 1994, the Commission conducted two auctions of Narrowband PCS licenses. For these auctions, the Commission defined a “small business” as an entity with average annual gross revenues for the preceding three years not exceeding \$40 million.⁷⁵ Through these auctions, the Commission awarded a total of 41 licenses, 11 of which were obtained by four small businesses.⁷⁶ To ensure meaningful participation by small business entities in future auctions, the Commission adopted a two-tiered small business size standard in the *Narrowband PCS Second Report and Order*.⁷⁷ A “small business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$40 million.⁷⁸ A “very small

⁶⁸ See Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66, AU Docket No. 06-30, *Public Notice*, 21 FCC Rcd 4562 (2006) (*Auction 66 Procedures Public Notice*);

⁶⁹ See Service Rules for Advanced Wireless Services in the 1.7 GHz and 2.1 GHz Bands, *Report and Order*, 18 FCC Rcd 25,162, App. B (2003), *modified by* Service Rules for Advanced Wireless Services In the 1.7 GHz and 2.1 GHz Bands, *Order on Reconsideration*, 20 FCC Rcd 14,058, App. C (2005).

⁷⁰ See Auction of Advanced Wireless Services Licenses Scheduled for June 29, 2006; Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction No. 66, AU Docket No. 06-30, *Public Notice*, 21 FCC Rcd 4562 (2006) (*Auction 66 Procedures Public Notice*).

⁷¹ See Auction of Advanced Wireless Services Licenses Closes; Winning Bidders Announced for Auction No. 66, *Public Notice*, 21 FCC Rcd 10,521 (2006) (“*Auction 66 Closing Public Notice*”).

⁷² See *id.*

⁷³ See *AWS-1 and Broadband PCS Procedures Public Notice*, 23 FCC Rcd at 7499. Auction 78 also included an auction of broadband PCS licenses.

⁷⁴ See Auction of AWS-1 and Broadband PCS Licenses Closes, Winning Bidders Announced for Auction 78, *Down Payments Due September 9, 2008, FCC Forms 601 and 602 Due September 9, 2008, Final Payments Due September 23, 2008, Ten-Day Petition to Deny Period*, *Public Notice*, 23 FCC Rcd 12,749 (2008).

⁷⁵ *Implementation of Section 309(j) of the Communications Act – Competitive Bidding Narrowband PCS*, Third Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 10 FCC Rcd 175, 196, para. 46 (1994).

⁷⁶ See Announcing the High Bidders in the Auction of Ten Nationwide Narrowband PCS Licenses, Winning Bids Total \$617,006,674,” *Public Notice*, PNWL 94-004 (Aug. 2, 1994); “Announcing the High Bidders in the Auction of 30 Regional Narrowband PCS Licenses; Winning Bids Total \$490,901,787,” *Public Notice*, PNWL 94-27 (Nov. 9, 1994).

⁷⁷ *Amendment of the Commission’s Rules to Establish New Personal Communications Services*, Narrowband PCS, Second Report and Order and Second Further Notice of Proposed Rule Making, 15 FCC Rcd 10456, 10476, para. 40 (2000) (*Narrowband PCS Second Report and Order*).

⁷⁸ *Narrowband PCS Second Report and Order*, 15 FCC Rcd at 10476, para. 40.

business” is an entity that, together with affiliates and controlling interests, has average gross revenues for the three preceding years of not more than \$15 million.⁷⁹ The SBA has approved these small business size standards.⁸⁰ A third auction of Narrowband PCS licenses was conducted in 2001. In that auction, five bidders won 317 (Metropolitan Trading Areas and nationwide) licenses.⁸¹ Three of the winning bidders claimed status as a small or very small entity and won 311 licenses.

Lower 700 MHz Band Licenses. The Commission previously adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits.⁸² The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁸³ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁸⁴ Additionally, the Lower 700 MHz Service had a third category of small business status for Metropolitan/Rural Service Area (“MSA/RSA”) licenses —“entrepreneur”— which is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$3 million for the preceding three years.⁸⁵ The SBA approved these small size standards.⁸⁶ An auction of 740 licenses was conducted in 2002 (one license in each of the 734 MSAs/RSAs and one license in each of the six Economic Area Groupings (EAGs)). Of the 740 licenses available for auction, 484 licenses were won by 102 winning bidders. Seventy-two of the winning bidders claimed small business, very small business, or entrepreneur status and won a total of 329 licenses.⁸⁷ A second auction commenced on May 28, 2003, closed on June 13, 2003, and included 256 licenses.⁸⁸ Seventeen winning bidders claimed small or very small business status and won 60 licenses, and nine winning bidders claimed entrepreneur status and won 154 licenses.⁸⁹ In 2005, the Commission completed an auction of 5 licenses in the lower 700 MHz band (Auction 60). All three winning bidders claimed small business status.

In 2007, the Commission reexamined its rules governing the 700 MHz band in the *700 MHz Second Report and Order*.⁹⁰ An auction of A, B and E block licenses in the Lower 700 MHz band was held in

⁷⁹ *Id.*

⁸⁰ *See Alvarez Letter 1998.*

⁸¹ *See* Narrowband PCS Auction Closes, *Public Notice*, 16 FCC Rcd 18663 (WTB 2001).

⁸² *See Reallocation and Service Rules for the 698-746 MHz Spectrum Band (Television Channels 52-59)*, Report and Order, 17 FCC Rcd 1022 (2002) (“*Channels 52-59 Report and Order*”).

⁸³ *See Channels 52-59 Report and Order*, 17 FCC Rcd at 1087-88, para. 172.

⁸⁴ *See id.*

⁸⁵ *See id.* at 1088, para. 173.

⁸⁶ *See* Letter from Aida Alvarez, Administrator, SBA, to Thomas Sugrue, Chief, WTB, FCC (Aug. 10, 1999) (“*Alvarez Letter 1999*”).

⁸⁷ *See* Lower 700 MHz Band Auction Closes, *Public Notice*, 17 FCC Rcd 17272 (WTB 2002).

⁸⁸ *See* Lower 700 MHz Band Auction Closes, *Public Notice*, 18 FCC Rcd 11873 (WTB 2003).

⁸⁹ *See id.*

⁹⁰ Service Rules for the 698-746, 747-762 and 777-792 MHz Band, WT Docket No. 06-150, *Revision of the Commission’s Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, CC Docket No. 94-102, Section 68.4(a) of the Commission’s Rules Governing Hearing Aid-Compatible Telephone, WT Docket No. 01-309, *Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services*, WT Docket No. 03-264, *Former Nextel Communications, Inc. Upper 700 MHz Guard Band Licenses and Revisions to Part 27 of the Commission’s Rules*, WT Docket No. 06-169,

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2008.⁹¹ Twenty winning bidders claimed small business status (those with attributable average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years). Thirty-three winning bidders claimed very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years). In 2011, the Commission conducted Auction 92, which offered 16 lower 700 MHz band licenses that had been made available in Auction 73 but either remained unsold or were licenses on which a winning bidder defaulted. Two of the seven winning bidders in Auction 92 claimed very small business status, winning a total of four licenses.

Upper 700 MHz Band Licenses. In the *700 MHz Second Report and Order*, the Commission revised its rules regarding Upper 700 MHz licenses.⁹² On January 24, 2008, the Commission commenced Auction 73 in which several licenses in the Upper 700 MHz band were available for licensing: 12 Regional Economic Area Grouping licenses in the C Block, and one nationwide license in the D Block.⁹³ The auction concluded on March 18, 2008, with 3 winning bidders claiming very small business status (those with attributable average annual gross revenues that do not exceed \$15 million for the preceding three years) and winning five licenses.

700 MHz Guard Band Licenses. In 2000, the Commission adopted the *700 MHz Guard Band Report and Order*, in which it established rules for the A and B block licenses in the Upper 700 MHz band, including size standards for “small businesses” and “very small businesses” for purposes of determining their eligibility for special provisions such as bidding credits.⁹⁴ A small business in this service is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$40 million for the preceding three years.⁹⁵ Additionally, a very small business is an entity that, together with its affiliates and controlling principals, has average gross revenues that are not more than \$15 million for the preceding three years.⁹⁶ SBA approval of these definitions is not required.⁹⁷ An auction of these licenses was conducted in 2000.⁹⁸ Of the 104 licenses auctioned, 96 licenses were won by nine bidders. Five of these bidders were small businesses that won a total of 26 licenses. A second auction of 700 MHz Guard Band licenses was held in 2001. All eight of the licenses auctioned were sold to three bidders. One of these bidders was a small business that won a total of two licenses.⁹⁹

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Implementing a Nationwide, Broadband Interoperable Public Safety Network in the 700 MHz Band, PS Docket No. 06-229, *Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State, and Local Public Safety Communications Requirements Through the Year 2010*, WT Docket No. 96-86, Second Report and Order, 22 FCC Rcd 15289 (2007) (*700 MHz Second Report and Order*).

⁹¹ See Auction of 700 MHz Band Licenses Closes, *Public Notice*, 23 FCC Rcd 4572 (WTB 2008).

⁹² *700 MHz Second Report and Order*, 22 FCC Rcd 15289.

⁹³ See Auction of 700 MHz Band Licenses Closes, *Public Notice*, 23 FCC Rcd 4572 (WTB 2008).

⁹⁴ See *Service Rules for the 746-764 MHz Bands, and Revisions to Part 27 of the Commission's Rules*, Second Report and Order, 15 FCC Rcd 5299 (2000) (*700 MHz Guard Band Report and Order*).

⁹⁵ See *700 MHz Guard Band Report and Order*, 15 FCC Rcd at 5343, para. 108.

⁹⁶ See *id.*

⁹⁷ See *id.* at 5343, para. 108 n.246 (for the 746-764 MHz and 776-794 MHz bands, the Commission is exempt from 15 U.S.C. § 632, which requires Federal agencies to obtain SBA approval before adopting small business size standards).

⁹⁸ See 700 MHz Guard Bands Auction Closes: Winning Bidders Announced, *Public Notice*, 15 FCC Rcd 18026 (2000).

⁹⁹ See 700 MHz Guard Bands Auction Closes: Winning Bidders Announced, *Public Notice*, 16 FCC Rcd 4590 (WTB 2001).

Specialized Mobile Radio. The Commission adopted small business size standards for the purpose of determining eligibility for bidding credits in auctions of Specialized Mobile Radio (SMR) geographic area licenses in the 800 MHz and 900 MHz bands. The Commission defined a “small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.¹⁰⁰ The Commission defined a “very small business” as an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$3 million for the preceding three years.¹⁰¹ The SBA has approved these small business size standards for both the 800 MHz and 900 MHz SMR Service.¹⁰² The first 900 MHz SMR auction was completed in 1996. Sixty bidders claiming that they qualified as small businesses under the \$15 million size standard won 263 licenses in the 900 MHz SMR band. In 2004, the Commission held a second auction of 900 MHz SMR licenses and three winning bidders identifying themselves as very small businesses won 7 licenses.¹⁰³ The auction of 800 MHz SMR licenses for the upper 200 channels was conducted in 1997. Ten bidders claiming that they qualified as small or very small businesses under the \$15 million size standard won 38 licenses for the upper 200 channels.¹⁰⁴ A second auction of 800 MHz SMR licenses was conducted in 2002 and included 23 BEA licenses. One bidder claiming small business status won five licenses.¹⁰⁵

The auction of the 1,053 800 MHz SMR geographic area licenses for the General Category channels was conducted in 2000. Eleven bidders who won 108 licenses for the General Category channels in the 800 MHz SMR band qualified as small or very small businesses.¹⁰⁶ In an auction completed in 2000, a total of 2,800 Economic Area licenses in the lower 80 channels of the 800 MHz SMR service were awarded.¹⁰⁷ Of the 22 winning bidders, 19 claimed small or very small business status and won 129 licenses. Thus, combining all four auctions, 41 winning bidders for geographic licenses in the 800 MHz SMR band claimed to be small businesses.

In addition, there are numerous incumbent site-by-site SMR licensees and licensees with extended implementation authorizations in the 800 and 900 MHz bands. We do not know how many firms provide 800 MHz or 900 MHz geographic area SMR service pursuant to extended implementation authorizations, nor how many of these providers have annual revenues not exceeding \$15 million. One firm has over \$15 million in revenues. In addition, we do not know how many of these firms have 1,500 or fewer employees, which is the SBA-determined size standard.¹⁰⁸ We assume, for purposes of this analysis, that all of the remaining extended implementation authorizations are held by small entities, as that small business size standard is approved by the SBA.

¹⁰⁰ 47 CFR §§ 90.810, 90.814(b), 90.912(b).

¹⁰¹ 47 CFR §§ 90.810, 90.814(b), 90.912(b).

¹⁰² See *Alvarez Letter 1999*.

¹⁰³ See 900 MHz Specialized Mobile Radio Service Spectrum Auction Closes: Winning Bidders Announced, *Public Notice*, 19 FCC Rcd 3921 (WTB 2004).

¹⁰⁴ See Correction to Public Notice DA 96-586 FCC Announces Winning Bidders in the Auction of 1020 Licenses to Provide 900 MHz SMR in Major Trading Areas, *Public Notice*, 18 FCC Rcd 18367 (WTB 1996).

¹⁰⁵ See Multi-Radio Service Auction Closes, *Public Notice*, 17 FCC Rcd 1446 (WTB 2002).

¹⁰⁶ See 800 MHz Specialized Mobile Radio (SMR) Service General Category (851-854 MHz) and Upper Band (861-865 MHz) Auction Closes; Winning Bidders Announced, *Public Notice*, 15 FCC Rcd 17162 (2000).

¹⁰⁷ See 800 MHz SMR Service Lower 80 Channels Auction Closes; Winning Bidders Announced, *Public Notice*, 16 FCC Rcd 1736 (2000).

¹⁰⁸ See generally 13 CFR § 121.201, NAICS code 517312.

220 MHz Radio Service – Phase I Licensees. The 220 MHz service has both Phase I and Phase II licenses. Phase I licensing was conducted by lotteries in 1992 and 1993. There are approximately 1,515 such non-nationwide licensees and four nationwide licensees currently authorized to operate in the 220 MHz band. The Commission has not developed a small business size standard for small entities specifically applicable to such incumbent 220 MHz Phase I licensees. To estimate the number of such licensees that are small businesses, the Commission applies the small business size standard under the SBA rules applicable to Wireless Telecommunications Carriers (except Satellite). Under this category, the SBA deems a wireless business to be small if it has 1,500 or fewer employees.¹⁰⁹ Thus, under this category and the associated small business size standard, the majority of firms can be considered small.

220 MHz Radio Service – Phase II Licensees. The 220 MHz service has both Phase I and Phase II licenses. The Phase II 220 MHz service licenses are assigned by auction, where mutually exclusive applications are accepted. In the *220 MHz Third Report and Order*, the Commission adopted a small business size standard for defining “small” and “very small” businesses for purposes of determining their eligibility for special provisions such as bidding credits.¹¹⁰ This small business standard indicates that a “small business” is an entity that, together with its affiliates and controlling principals, has average gross revenues not exceeding \$15 million for the preceding three years.¹¹¹ A “very small business” is defined as an entity that, together with its affiliates and controlling principals, has average gross revenues that do not exceed \$3 million for the preceding three years.¹¹² The SBA has approved these small business size standards.¹¹³ Auctions of Phase II licenses commenced and closed in 1998.¹¹⁴ In the first auction, 908 licenses were auctioned in three different-sized geographic areas: three nationwide licenses, 30 Regional Economic Area Group (EAG) Licenses, and 875 Economic Area (EA) Licenses. Of the 908 licenses auctioned, 693 were sold.¹¹⁵ Thirty-nine small businesses won 373 licenses in the first 220 MHz auction. A second auction included 225 licenses: 216 EA licenses and 9 EAG licenses. Fourteen companies claiming small business status won 158 licenses.¹¹⁶ A third auction included four licenses: 2 BEA licenses and 2 EAG licenses in the 220 MHz Service. No small or very small business won any of these licenses.¹¹⁷ In 2007, the Commission conducted a fourth auction of the 220 MHz licenses, designated as Auction 72.¹¹⁸ Auction 72, which offered 94 Phase II 220 MHz Service licenses, concluded in 2007.¹¹⁹

¹⁰⁹ 13 CFR § 121.201, NAICS code 517312.

¹¹⁰ *Amendment of Part 90 of the Commission’s Rules to Provide For the Use of the 220-222 MHz Band by the Private Land Mobile Radio Service*, Third Report and Order and Fifth Notice of Proposed Rulemaking, 12 FCC Rcd 10943, 11068-70, paras. 291-95 (1997).

¹¹¹ *Id.* at 11068, para. 291.

¹¹² *Id.*

¹¹³ See Letter to Daniel Phythyon, Chief, Wireless Telecommunications Bureau, Federal Communications Commission, from Aida Alvarez, Administrator, Small Business Administration, dated January 6, 1998 (*Alvarez to Phythyon Letter 1998*).

¹¹⁴ See generally *220 MHz Service Auction Closes*, Public Notice, 14 FCC Rcd 605 (WTB 1998).

¹¹⁵ See *FCC Announces It is Prepared to Grant 654 Phase II 220 MHz Licenses After Final Payment is Made*, Public Notice, 14 FCC Rcd 1085 (WTB 1999).

¹¹⁶ See *Phase II 220 MHz Service Spectrum Auction Closes*, Public Notice, 14 FCC Rcd 11218 (WTB 1999).

¹¹⁷ See *Multi-Radio Service Auction Closes*, Public Notice, 17 FCC Rcd 1446 (WTB 2002).

¹¹⁸ See Auction of Phase II 220 MHz Service Spectrum Scheduled for June 20, 2007, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments and Other Procedures for Auction 72, *Public Notice*, 22 FCC Rcd 3404 (2007).

¹¹⁹ See *Auction of Phase II 220 MHz Service Spectrum Licenses Closes, Winning Bidders Announced for Auction 72, Down Payments due July 18, 2007, FCC Forms 601 and 602 due July 18, 2007, Final Payments due August 1, 2007, Ten-Day Petition to Deny Period*, Public Notice, 22 FCC Rcd 11573 (2007).

In this auction, five winning bidders won a total of 76 licenses. Two winning bidders identified themselves as very small businesses won 56 of the 76 licenses. One of the winning bidders that identified themselves as a small business won 5 of the 76 licenses won.

Private Land Mobile Radio (PLMR). Private land mobile radio systems serve an essential role in a vast range of industrial, business, land transportation, and public safety activities. Companies of all sizes operating in all U.S. business categories use these radios. Because of the vast array of PLMR users, the Commission has not developed a small business size standard specifically applicable to PLMR users. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite) which encompasses business entities engaged in *radiotelephone communications*.¹²⁰ The appropriate size standard for this category under SBA rules is that such a business is small if it has 1,500 or fewer employees.¹²¹ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.¹²² Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹²³ Thus, under this category and the associated size standard, the Commission estimates that the majority of PLMR Licensees are small entities.

According to the Commission's records, a total of approximately 400,622 licenses comprise PLMR users.¹²⁴ Of this number there are a total of approximately 3,174 PLMR licenses in the 4.9 GHz band;¹²⁵ 29,187 PLMR licenses in the 800 MHz band;¹²⁶ and 3,374 licenses in the frequencies range 173.225 MHz to 173.375 MHz.¹²⁷ The Commission does not require PLMR licensees to disclose information about number of employees, and does not have information that could be used to determine how many PLMR licensees constitute small entities under this definition. The Commission, however, believes that a substantial number of PLMR licensees may be small entities despite the lack of specific information.

Fixed Microwave Services. Microwave services include common carrier,¹²⁸ private-operational fixed,¹²⁹ and broadcast auxiliary radio services.¹³⁰ They also include the Upper Microwave Flexible Use

¹²⁰ U.S. Census Bureau, 2012 NAICS Definitions, "517210 Wireless Telecommunications Carriers (Except Satellite)," *see* <https://factfinder.census.gov/faces/affhelp/jsf/pages/metadata.xhtml?lang=en&type=ib&id=ib.en/ECN/NAICS2012.517210>.

¹²¹ *See* 13 CFR § 121.201, NAICS code 517312.

¹²² U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹²³ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

¹²⁴ This figure was derived from Commission licensing records as of September 19, 2016. Licensing numbers change on a daily basis. This does not indicate the number of licensees, as licensees may hold multiple licenses. There is no information currently available about the number of PLMR licensees that have fewer than 1,500 employees.

¹²⁵ Based on an FCC Universal Licensing System search of January 26, 2018. Search parameters: Radio Service = PA – Public Safety 4940-4990 MHz Band; Authorization Type = Regular; Status = Active.

¹²⁶ Based on an FCC Universal Licensing System search of May 15, 2017. Search parameters: Radio Service = GB, GE, GF, GJ, GM, GO, GP, YB, YE, YF, YJ, YM, YO, YP, YX; Authorization Type = Regular; Status = Active.

¹²⁷ This figure was derived from Commission licensing records as of August 16, 2013. Licensing numbers change daily. We do not expect this number to be significantly smaller today. This does not indicate the number of licensees, as licensees may hold multiple licenses. There is no information currently available about the number of licensees that have fewer than 1,500 employees.

¹²⁸ *See* 47 CFR Part 101, Subparts C and I.

Service,¹³¹ Millimeter Wave Service,¹³² Local Multipoint Distribution Service (LMDS),¹³³ the Digital Electronic Message Service (DEMS),¹³⁴ and the 24 GHz Service,¹³⁵ where licensees can choose between common carrier and non-common carrier status.¹³⁶ At present, there are approximately 66,680 common carrier fixed licensees, 69,360 private and public safety operational-fixed licensees, 20,150 broadcast auxiliary radio licensees, 411 LMDS licenses, 33 24 GHz DEMS licenses, 777 39 GHz licenses, and five 24 GHz licenses, and 467 Millimeter Wave licenses in the microwave services.¹³⁷ The Commission has not yet defined a small business with respect to microwave services. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite) and the appropriate size standard for this category under SBA rules is that such a business is small if it has 1,500 or fewer employees.¹³⁸ For this industry, U.S. Census data for 2012 show that there were 967 firms that operated for the entire year.¹³⁹ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁴⁰ Thus, under this SBA category and the associated size standard, the Commission estimates that a majority of fixed microwave service licensees can be considered small.

The Commission does not have data specifying the number of these licensees that have more than 1,500 employees, and thus is unable at this time to estimate with greater precision the number of fixed microwave service licensees that would qualify as small business concerns under the SBA's small business size standard. Consequently, the Commission estimates that there are up to 36,708 common carrier fixed licensees and up to 59,291 private operational-fixed licensees and broadcast auxiliary radio licensees in the microwave services that may be small and may be affected by the rules and policies adopted herein. We note, however, that the common carrier microwave fixed licensee category does include some large entities.

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¹²⁹ See 47 CFR Part 101, Subparts C and H. Persons eligible under parts 80 and 90 of the Commission's rules can use Private-Operational Fixed Microwave Services. See 47 CFR pts. 80, 90. Stations in this service are called operational-fixed to distinguish them from common carrier and public fixed stations. Only the licensee may use the operational-fixed station and only for communications related to the licensee's commercial, industrial, or safety operations.

¹³⁰ See 47 CFR pts. 74, 78 (governing Auxiliary Microwave Service). Available to licensees of broadcast stations, cable operators, and to broadcast and cable network entities, 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 and CARS pickup, which relay signals from a remote location back to the studio.

¹³¹ See 47 CFR Part 30.

¹³² See 47 CFR Part 101, Subpart Q.

¹³³ See 47 CFR Part 101, Subpart L.

¹³⁴ See 47 CFR Part 101, Subpart G.

¹³⁵ See *id.*

¹³⁶ See 47 CFR §§ 101.533, 101.1017.

¹³⁷ These statistics are based on a review of the Universal Licensing System on September 22, 2015.

¹³⁸ See 13 CFR § 121.201, NAICS code 517312.

¹³⁹ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series, "Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210" (rel. Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹⁴⁰ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

39 GHz Service. The Commission created a special small business size standard for 39 GHz licenses—an entity that has average gross revenues of \$40 million or less in the three previous calendar years.¹⁴¹ An additional size standard for “very small business” is: an entity that, together with affiliates, has average gross revenues of not more than \$15 million for the preceding three calendar years.¹⁴² The SBA has approved these small business size standards.¹⁴³ The auction of the 2,173 39 GHz licenses began on April 12, 2000, and closed on May 8, 2000. The 18 bidders who claimed small business status won 849 licenses. Consequently, the Commission estimates that 18 or fewer 39 GHz licensees are small entities that may be affected by rules adopted pursuant to the Second Report and Order.

Local Multipoint Distribution Service. Local Multipoint Distribution Service (“LMDS”) is a fixed broadband point-to-multipoint microwave service that provides for two-way video telecommunications.¹⁴⁴ The Commission established a small business size standard for LMDS licenses as an entity that, together with its affiliates and controlling principals, has average gross revenues of less than \$40 million in the three previous years.¹⁴⁵ An additional small business size standard for “very small business” was added as an entity that, together with its affiliates and controlling principals, has average gross revenues of not more than \$15 million for the preceding three years.¹⁴⁶ The SBA has approved these small business size standards in the context of LMDS auctions.¹⁴⁷ There were 93 winning bidders that qualified as small entities in the LMDS auctions. A total of 93 small and very small businesses won approximately 277 A Block licenses and 387 B Block licenses. In 1999, the Commission re-auctioned 161 licenses and there were 32 small and very small businesses that won 119 licenses.

218-219 MHz Service. The first auction of 218-219 MHz spectrum resulted in 170 entities winning licenses for 594 Metropolitan Statistical Area (MSA) licenses. Of the 594 licenses, 557 were won by entities qualifying as a small business. For that auction, the small business size standard was an entity that, together with its affiliates, has no more than a \$6 million net worth and, after federal income taxes (excluding any carry over losses), has no more than \$2 million in annual profits each year for the previous two years.¹⁴⁸ In the *218-219 MHz Report and Order and Memorandum Opinion and Order*, we established a small business size standard for a “small business” as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and their affiliates, has average annual

¹⁴¹ See *Amendment of the Commission’s Rules Regarding the 37.0-38.6 GHz and 38.6-40.0 GHz Bands*, ET Docket No. 95-183, PP Docket No. 93-253, Report and Order, 12 FCC Rcd 18600, 18661–64, paras. 149–51 (1997).

¹⁴² See *id.*

¹⁴³ See Letter to Kathleen O’Brien Ham, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, Federal Communications Commission, from Aida Alvarez, Administrator, SBA (Feb. 4, 1998).

¹⁴⁴ See *Rulemaking to Amend Parts 1, 2, 21, 25, of the Commission’s Rules to Redesignate the 27.5-29.5 GHz Frequency Band, Reallocate the 29.5-30.5 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*, CC Docket No. 92-297, Second Report and Order, Order on Reconsideration, and Fifth Notice of Proposed Rule Making, 12 FCC Rcd 12545, 12689-90, para. 348 (1997) (“*LMDS Second Report and Order*”).

¹⁴⁵ See [LMDS Second Report and Order, 12 FCC Rcd at 12689-90, para. 348](#).

¹⁴⁶ See *id.*

¹⁴⁷ See Letter to D. Phythyon, Chief, Wireless Telecommunications Bureau, Federal Communications Commission, from Aida Alvarez, Administrator, SBA (Jan. 6, 1998) (Alvarez to Phythyon Letter 1998).

¹⁴⁸ See generally *Implementation of Section 309(j) of the Communications Act – Competitive Bidding*, PP Docket No. 93-253, Fourth Report and Order, 9 FCC Rcd 2330 (1994).

gross revenues not to exceed \$15 million for the preceding three years.¹⁴⁹ A “very small business” is defined as an entity that, together with its affiliates and persons or entities that hold interests in such an entity and its affiliates, has average annual gross revenues not to exceed \$3 million for the preceding three years.¹⁵⁰ These size standards will be used in future auctions of 218-219 MHz spectrum.

Location and Monitoring Service (LMS). LMS systems use non-voice radio techniques to determine the location and status of mobile radio units. For purposes of auctioning LMS licenses, the Commission has defined a “small business” as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not to exceed \$15 million.¹⁵¹ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not to exceed \$3 million.¹⁵² These definitions have been approved by the SBA.¹⁵³ An auction for LMS licenses commenced on February 23, 1999, and closed on March 5, 1999. Of the 528 licenses auctioned, 289 licenses were sold to four small businesses.

Rural Radiotelephone Service. The Commission has not adopted a size standard for small businesses specific to the Rural Radiotelephone Service.¹⁵⁴ A significant subset of the Rural Radiotelephone Service is the Basic Exchange Telephone Radio System (BETRS).¹⁵⁵ The closest applicable SBA size standard is for Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.¹⁵⁶ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.¹⁵⁷ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁵⁸ Thus, under this category and the associated size standard, the Commission estimates that the majority of Rural Radiotelephone Services firm are small entities. There are approximately 1,000 licensees in the Rural Radiotelephone Service, and the Commission estimates that there are 1,000 or fewer small entity licensees in the Rural Radiotelephone Service that may be affected by the rules and policies adopted pursuant to the Second Report and Order.

Air-Ground Radiotelephone Service. The Commission has previously used the SBA’s small business size standard applicable to Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.¹⁵⁹ For this industry, U.S. Census data for 2012 show that there

¹⁴⁹ See generally *Amendment of Part 95 of the Commission’s Rules to Provide Regulatory Flexibility in the 218-219 MHz Service*, WT Docket No. 98-169, Report and Order and Memorandum Opinion and Order, 15 FCC Rcd 1497 (1999) (*218-219 MHz Report and Order and Memorandum Opinion and Order*).

¹⁵⁰ See *id.*

¹⁵¹ Amendment of Part 90 of the Commission’s Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems, PR Docket No. 93-61, *Second Report and Order*, 13 FCC Rcd 15182, 15192, para. 20 (1998); see also 47 CFR § 90.1103.

¹⁵² *Id.*

¹⁵³ See Letter from Aida Alvarez, Administrator, Small Business Administration to Thomas J. Sugrue, Chief, Wireless Telecommunications Bureau, FCC (Feb. 22, 1999).

¹⁵⁴ The service is defined in 47 CFR § 22.99.

¹⁵⁵ BETRS is defined in 47 CFR §§ 22.757 and 22.759.

¹⁵⁶ 13 CFR § 121.201, NAICS code 517312.

¹⁵⁷ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹⁵⁸ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

¹⁵⁹ 13 CFR § 121.201, NAICS code 517312.

were 967 firms that operated for the entire year. Of this total, 955 firms had fewer than 1,000 employees and 12 had employment of 1000 employees or more.¹⁶⁰ There are approximately 100 licensees in the Air-Ground Radiotelephone Service, and we estimate that almost all of them qualify as small entities under the SBA definition. For purposes of assigning Air-Ground Radiotelephone Service licenses through competitive bidding, the Commission has defined “small business” as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$40 million.¹⁶¹ A “very small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the preceding three years not exceeding \$15 million.¹⁶² These definitions were approved by the SBA.¹⁶³ In May 2006, the Commission completed an auction of nationwide commercial Air-Ground Radiotelephone Service licenses in the 800 MHz band (Auction No. 65). On June 2, 2006, the auction closed with two winning bidders winning two Air-Ground Radiotelephone Services licenses. Neither of the winning bidders claimed small business status.

Aviation and Marine Radio Services. Small businesses in the aviation and marine radio services use a very high frequency (VHF) marine or aircraft radio and, as appropriate, an emergency position-indicating radio beacon (and/or radar) or an emergency locator transmitter. The Commission has not developed a small business size standard specifically applicable to these small businesses. For purposes of this analysis, the Commission uses the SBA small business size standard for the category Wireless Telecommunications Carriers (except Satellite), which is 1,500 or fewer employees.¹⁶⁴ U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.¹⁶⁵ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁶⁶ Most applicants for recreational licenses are individuals. Approximately 581,000 ship station licensees and 131,000 aircraft station licensees operate domestically and are not subject to the radio carriage requirements of any statute or treaty. For purposes of our evaluations in this analysis, we estimate that there are up to approximately 712,000 licensees that are small businesses (or individuals) under the SBA standard. In addition, between December 3, 1998 and December 14, 1998, the Commission held an auction of 42 VHF Public Coast licenses in the 157.1875-157.4500 MHz (ship transmit) and 161.775-162.0125 MHz (coast transmit) bands. For purposes of the auction, the Commission defined a “small” business as an entity that, together with controlling interests and affiliates, has average gross revenues for

¹⁶⁰ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

¹⁶¹ *Amendment of Part 22 of the Commission’s Rules to Benefit the Consumers of Air-Ground Telecommunications Services, Biennial Regulatory Review—Amendment of Parts 1, 22, and 90 of the Commission’s Rules, Amendment of Parts 1 and 22 of the Commission’s Rules to Adopt Competitive Bidding Rules for Commercial and General Aviation Air-Ground Radiotelephone Service, Order on Reconsideration and Report and Order*, 20 FCC Rcd 19663, paras. 28-42 (2005).

¹⁶² *Id.*

¹⁶³ See Letter from Hector V. Barreto, Administrator, SBA, to Gary D. Michaels, Deputy Chief, Auctions and Spectrum Access Division, Wireless Telecommunications Bureau, Federal Communications Commission (filed Sept. 19, 2005).

¹⁶⁴ See 13 CFR § 121.201, NAICS code 517312.

¹⁶⁵ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (Jan. 8, 2016), https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹⁶⁶ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

the preceding three years not to exceed \$15 million dollars.¹⁶⁷ In addition, a “very small” business is one that, together with controlling interests and affiliates, has average gross revenues for the preceding three years not to exceed \$3 million dollars.¹⁶⁸ There are approximately 10,672 licensees in the Marine Coast Service, and the Commission estimates that almost all of them qualify as “small” businesses under the above special small business size standards.

Offshore Radiotelephone Service. This service operates on several UHF television broadcast channels that are not used for television broadcasting in the coastal areas of states bordering the Gulf of Mexico.¹⁶⁹ The closest applicable SBA size standard is for Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.¹⁷⁰ U.S. Census Bureau data in this industry for 2012 show that there were 967 firms that operated for the entire year.¹⁷¹ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁷² Thus, under this SBA category and the associated small business size standard, the majority of Offshore Radiotelephone Service firms can be considered small. There are presently approximately 55 licensees in this service. However, the Commission is unable to estimate at this time the number of licensees that would qualify as small under the SBA’s small business size standard for the category of Wireless Telecommunications Carriers (except Satellite).

Multiple Address Systems. Entities using Multiple Address Systems (MAS) spectrum, in general, fall into two categories: (1) those using the spectrum for profit-based uses, and (2) those using the spectrum for private internal uses. With respect to the first category, Profit-based Spectrum use, the size standards established by the Commission define “small entity” for MAS licensees as an entity that has average annual gross revenues of less than \$15 million over the three previous calendar years.¹⁷³ A “Very small business” is defined as an entity that, together with its affiliates, has average annual gross revenues of not more than \$3 million over the preceding three calendar years.¹⁷⁴ The SBA has approved these definitions.¹⁷⁵ The majority of MAS operators are licensed in bands where the Commission has implemented a geographic area licensing approach that requires the use of competitive bidding procedures to resolve mutually exclusive applications.

The Commission’s licensing database indicates that, as of April 16, 2010, there were a total of 11,653 site-based MAS station authorizations. Of these, 58 authorizations were associated with common carrier service. In addition, the Commission’s licensing database indicates that, as of April 16, 2010, there were

¹⁶⁷ See generally *Amendment of the Commission’s Rules Concerning Maritime Communications*, PR Docket No. 92-257, Third Report and Order and Memorandum Opinion and Order, 13 FCC Rcd 19853, 19884-88, paras. 64-73 (1998).

¹⁶⁸ See *id.*

¹⁶⁹ This service is governed by Subpart I of Part 22 of the Commission’s Rules. See 47 CFR §§ 22.1001-22.1037.

¹⁷⁰ 13 CFR § 121.201, NAICS code 517312.

¹⁷¹ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~5172100.

¹⁷² *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

¹⁷³ See *Amendment of the Commission’s Rules Regarding Multiple Address Systems, Report and Order*, 15 FCC Rcd 11956, 12008, para. 123 (2000).

¹⁷⁴ *Id.*

¹⁷⁵ See Letter from Aida Alvarez, Administrator, Small Business Administration, to Thomas Sugrue, Chief, Wireless Telecommunications Bureau, FCC (June 4, 1999).

a total of 3,330 Economic Area market area MAS authorizations. The Commission's licensing database also indicates that, as of April 16, 2010, of the 11,653 total MAS station authorizations, 10,773 authorizations were for private radio service. In 2001, an auction for 5,104 MAS licenses in 176 EAs was conducted.¹⁷⁶ Seven winning bidders claimed status as small or very small businesses and won 611 licenses. In 2005, the Commission completed an auction (Auction 59) of 4,226 MAS licenses in the Fixed Microwave Services from the 928/959 and 932/941 MHz bands. Twenty-six winning bidders won a total of 2,323 licenses. Of the 26 winning bidders in this auction, five claimed small business status and won 1,891 licenses.

With respect to the second category, Internal Private Spectrum use consists of entities that use, or seek to use, MAS spectrum to accommodate their own internal communications needs, MAS serves an essential role in a range of industrial, safety, business, and land transportation activities. MAS radios are used by companies of all sizes, operating in virtually all U.S. business categories, and by all types of public safety entities. For the majority of private internal users, the definition developed by the SBA would be more appropriate than the Commission's definition. The closest applicable definition of a small entity is the "Wireless Telecommunications Carriers (except Satellite)" definition under the SBA rules.¹⁷⁷ The appropriate size standard under SBA rules is that such a business is small if it has 1,500 or fewer employees.¹⁷⁸ For this category, U.S. Census data for 2012 show that there were 967 firms that operated for the entire year.¹⁷⁹ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁸⁰ Thus, under this category and the associated small business size standard, the Commission estimates that the majority of firms that may be affected by our action can be considered small.

1.4 GHz Band Licensees. The Commission conducted an auction of 64 1.4 GHz band licenses in the paired 1392-1395 MHz and 1432-1435 MHz bands, and in the unpaired 1390-1392 MHz band in 2007.¹⁸¹ For these licenses, the Commission defined "small business" as an entity that, together with its affiliates and controlling interests, had average gross revenues not exceeding \$40 million for the preceding three years, and a "very small business" as an entity that, together with its affiliates and controlling interests, has had average annual gross revenues not exceeding \$15 million for the preceding three years.¹⁸² Neither of the two winning bidders claimed small business status.¹⁸³

Incumbent 24 GHz Licensees. This analysis may affect incumbent licensees who were relocated to the 24 GHz band from the 18 GHz band and applicants who wish to provide services in the 24 GHz band. For this service, the Commission uses the SBA small business size standard for the category "Wireless

¹⁷⁶ See *Multiple Address Systems Spectrum Auction Closes*, Public Notice, 16 FCC Rcd 21011 (2001).

¹⁷⁷ 13 CFR § 121.201, NAICS Code 517312.

¹⁷⁸ *Id.*

¹⁷⁹ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹⁸⁰ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

¹⁸¹ See *Auction of 1.4 GHz Band Licenses Scheduled for February 7, 2007*, Public Notice, 21 FCC Rcd 12393 (WTB 2006); *Auction of 1.4 GHz Band Licenses Closes; Winning Bidders Announced for Auction No. 69*, Public Notice, 22 FCC Rcd 4714 (2007) (*Auction No. 69 Closing PN*).

¹⁸² *Auction No. 69 Closing PN*, Attachment C.

¹⁸³ See *Auction No. 69 Closing PN*.

Telecommunications Carriers (Except Satellite),” which is 1,500 or fewer employees.¹⁸⁴ To gauge small business prevalence for these cable services we must, however, use the most current census data. For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.¹⁸⁵ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.¹⁸⁶ Thus, under this category and the associated small business size standard, the majority of firms can be considered small. The Commission notes that the U.S. Census Bureau’s use of the classification “firms” does not track the number of “licenses.” The Commission believes that there are only two licensees in the 24 GHz band that were relocated from the 18 GHz band, Teligent¹⁸⁷ and TRW, Inc. It is our understanding that Teligent and its related companies have less than 1,500 employees, though this may change in the future. TRW is not a small entity. Thus, only one incumbent licensee in the 24 GHz band is a small business entity.

Future 24 GHz Licensees. With respect to new applicants for licenses in the 24 GHz band, for the purpose of determining eligibility for bidding credits, the Commission established three small business definitions. An “entrepreneur” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$40 million.¹⁸⁸ A “small business” is defined as an entity that, together with controlling interests and affiliates, has average annual gross revenues for the three preceding years not exceeding \$15 million.¹⁸⁹ A “very small business” in the 24 GHz band is defined as an entity that, together with controlling interests and affiliates, has average gross revenues not exceeding \$3 million for the preceding three years.¹⁹⁰ The SBA has approved these small business size standards.¹⁹¹ In a 2004 auction of 24 GHz licenses, three winning bidders won seven licenses.¹⁹² Two of the winning bidders were very small businesses that won five licenses.

Broadband Radio Service and Educational Broadband Service. Broadband Radio Service systems, previously referred to as Multipoint Distribution Service (MDS) and Multichannel Multipoint Distribution Service (MMDS) systems, and “wireless cable,” transmit video programming to subscribers and provide two-way high speed data operations using the microwave frequencies of the Broadband

¹⁸⁴ 13 CFR § 121.201, NAICS code 517312.

¹⁸⁵ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210. https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

¹⁸⁶ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

¹⁸⁷ Teligent acquired the DEMS licenses of FirstMark, the only licensee other than TRW in the 24 GHz band whose license has been modified to require relocation to the 24 GHz band.

¹⁸⁸ *Amendments to Parts 1, 2, 87 and 101 of the Commission’s Rules to License Fixed Services at 24 GHz*, Report and Order, 15 FCC Rcd 16934, 16967 ¶ 77 (2000) (“24 GHz Report and Order”); *see also* 47 CFR § 101.538(a)(3).

¹⁸⁹ *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; *see also* 47 CFR § 101.538(a)(2).

¹⁹⁰ *24 GHz Report and Order*, 15 FCC Rcd at 16967 ¶ 77; *see also* 47 CFR § 101.538(a)(1).

¹⁹¹ *See* Letter to Margaret W. Wiener, Deputy Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC, from Gary M. Jackson, Assistant Administrator, SBA (July 28, 2000).

¹⁹² *Auction of 24 GHz Service Spectrum Auction Closes, Winning Bidders Announced for Auction 56, Down Payments Due August 16, 2004, Final Payments Due August 30, 2004, Ten-Day Petition to Deny Period*, Public Notice, 19 FCC Rcd 14738 (2004).

Radio Service (BRS) and Educational Broadband Service (EBS) (previously referred to as the Instructional Television Fixed Service (ITFS)).¹⁹³

BRS - In connection with the 1996 BRS auction, the Commission established a small business size standard as an entity that had annual average gross revenues of no more than \$40 million in the previous three calendar years.¹⁹⁴ The BRS auctions resulted in 67 successful bidders obtaining licensing opportunities for 493 Basic Trading Areas (BTAs). Of the 67 auction winners, 61 met the definition of a small business. BRS also includes licensees of stations authorized prior to the auction. At this time, we estimate that of the 61 small business BRS auction winners, 48 remain small business licensees. In addition to the 48 small businesses that hold BTA authorizations, there are approximately 86 incumbent BRS licensees that are considered small entities (18 incumbent BRS licensees do not meet the small business size standard).¹⁹⁵ After adding the number of small business auction licensees to the number of incumbent licensees not already counted, there are currently approximately 133 BRS licensees that are defined as small businesses under either the SBA or the Commission's rules.

In 2009, the Commission conducted Auction 86, the sale of 78 licenses in the BRS areas.¹⁹⁶ The Commission offered three levels of bidding credits: (i) a bidder with attributed average annual gross revenues that exceed \$15 million and do not exceed \$40 million for the preceding three years (small business) received a 15 percent discount on its winning bid; (ii) a bidder with attributed average annual gross revenues that exceed \$3 million and do not exceed \$15 million for the preceding three years (very small business) received a 25 percent discount on its winning bid; and (iii) a bidder with attributed average annual gross revenues that do not exceed \$3 million for the preceding three years (entrepreneur) received a 35 percent discount on its winning bid.¹⁹⁷ Auction 86 concluded in 2009 with the sale of 61 licenses.¹⁹⁸ Of the ten winning bidders, two bidders that claimed small business status won 4 licenses; one bidder that claimed very small business status won three licenses; and two bidders that claimed entrepreneur status won six licenses.

EBS - Educational Broadband Service has been included within the broad economic census category and SBA size standard for Wired Telecommunications Carriers since 2007. Wired Telecommunications Carriers are comprised of establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired telecommunications networks. Transmission facilities may be based on a single technology or a combination of technologies.¹⁹⁹ The SBA's small business size standard for

¹⁹³ *Amendment of Parts 21 and 74 of the Commission's Rules with Regard to Filing Procedures in the Multipoint Distribution Service and in the Instructional Television Fixed Service and Implementation of Section 309(j) of the Communications Act—Competitive Bidding*, Report and Order, 10 FCC Rcd 9589, 9593, para. 7 (1995).

¹⁹⁴ 47 CFR § 21.961(b)(1).

¹⁹⁵ 47 U.S.C. § 309(j). Hundreds of stations were licensed to incumbent MDS licensees prior to implementation of Section 309(j) of the Communications Act of 1934, 47 U.S.C. § 309(j). For these pre-auction licenses, the applicable standard is SBA's small business size standard of 1500 or fewer employees.

¹⁹⁶ *Auction of Broadband Radio Service (BRS) Licenses, Scheduled for October 27, 2009, Notice and Filing Requirements, Minimum Opening Bids, Upfront Payments, and Other Procedures for Auction 86*, Public Notice, 24 FCC Rcd 8277 (2009).

¹⁹⁷ *Id.* at 8296, para. 73.

¹⁹⁸ *Auction of Broadband Radio Service Licenses Closes, Winning Bidders Announced for Auction 86, Down Payments Due November 23, 2009, Final Payments Due December 8, 2009, Ten-Day Petition to Deny Period*, Public Notice, 24 FCC Rcd 13572 (2009).

¹⁹⁹ U.S. Census Bureau, 2017 NAICS Definitions, "517311 Wired Telecommunications Carriers," (partial definition), <http://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517311&search=2017>.

this category is all such firms having 1,500 or fewer employees.²⁰⁰ U.S. Census Bureau data for 2012 show that there were 3,117 firms that operated that year.²⁰¹ Of this total, 3,083 operated with fewer than 1,000 employees.²⁰² Thus, under this size standard, the majority of firms in this industry can be considered small. In addition to Census data, the Commission's Universal Licensing System indicates that as of October 2014, there are 2,206 active EBS licenses. The Commission estimates that of these 2,206 licenses, the majority are held by non-profit educational institutions and school districts, which are by statute defined as small businesses.²⁰³

Television Broadcasting. This Economic Census category "comprises establishments primarily engaged in broadcasting images together with sound."²⁰⁴ These establishments operate television broadcast studios and facilities for the programming and transmission of programs to the public.²⁰⁵ These establishments also produce or transmit visual programming to affiliated broadcast television stations, which in turn broadcast the programs to the public on a predetermined schedule. Programming may originate in their own studio, from an affiliated network, or from external sources. The SBA has created the following small business size standard for such businesses: those having \$38.5 million or less in annual receipts.²⁰⁶ The 2012 Economic Census reports that 751 firms in this category operated in that year.²⁰⁷ Of that number, 656 had annual receipts of \$25,000,000 or less, 25 had annual receipts between \$25,000,000 and \$49,999,999 and 70 had annual receipts of \$50,000,000 or more.²⁰⁸ Based on this data we therefore estimate that the majority of commercial television broadcasters are small entities under the applicable SBA size standard.

The Commission has estimated the number of licensed commercial television stations to be 1,387.²⁰⁹ Of this total, 1,258 stations (or about 91 percent) had revenues of \$38.5 million or less, according to Commission staff review of the BIA Kelsey Inc. Media Access Pro Television Database (BIA) on November 16, 2017, and therefore these licensees qualify as small entities under the SBA definition. In addition, the Commission has estimated the number of licensed noncommercial educational television

²⁰⁰ See, 13 CFR § 121.201. The Wired Telecommunications Carrier category formerly used the NAICS code of 517110. As of 2017 the U.S. Census Bureau definition shows the NAICS code as 517311 for Wired Telecommunications Carriers. See, <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?code=517311&search=2017>.

²⁰¹ See U.S. Census Bureau, *2012 Economic Census of the United States*, Table No. EC1251SSSZ5, *Information: Subject Series - Estab & Firm Size: Employment Size of Firms: 2012* (517110 Wired Telecommunications Carriers). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517110.

²⁰² *Id.*

²⁰³ The term "small entity" within SBREFA applies to small organizations (non-profits) and to small governmental jurisdictions (cities, counties, towns, townships, villages, school districts, and special districts with populations of less than 50,000). 5 U.S.C. §§ 601(4)-(6).

²⁰⁴ U.S. Census Bureau, 2017 NAICS Definitions, "515120 Television Broadcasting," <https://www.census.gov/cgi-bin/sssd/naics/naicsrch?input=515120&search=2017+NAICS+Search&search=2017>.

²⁰⁵ *Id.*

²⁰⁶ 13 CFR § 121.201; 2012 NAICS code 515120.

²⁰⁷ U.S. Census Bureau, Table No. EC1251SSSZ4, *Information: Subject Series - Establishment and Firm Size: Receipts Size of Firms for the United States: 2012* (515120 Television Broadcasting). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ4/naics~515120.

²⁰⁸ *Id.*

²⁰⁹ Broadcast Station Totals as of December 31, 2017, Press Release (MB Jan. 5, 2018), http://apps.fcc.gov/edocs_public/attachmatch/DOC-3485706998A1.pdf.

stations to be 395.²¹⁰ Notwithstanding, the Commission does not compile and otherwise does not have access to information on the revenue of NCE stations that would permit it to determine how many such stations would qualify as small entities. There are also 2,367 low power television stations, including Class A stations (LPTV) and 3,750 TV translator stations.²¹¹ Given the nature of these services, we will presume that all of these entities qualify as small entities under the above SBA small business size standard.

We note, however, that in assessing whether a business concern qualifies as “small” under the above definition, business (control) affiliations²¹² must be included. Our estimate, therefore, likely overstates the number of small entities that might be affected by our action, because the revenue figure on which it is based does not include or aggregate revenues from affiliated companies. In addition, another element of the definition of “small business” requires that an entity not be dominant in its field of operation. We are unable at this time to define or quantify the criteria that would establish whether a specific television broadcast station is dominant in its field of operation. Accordingly, the estimate of small businesses to which rules may apply does not exclude any television station from the definition of a small business on this basis and is therefore possibly over-inclusive. Also, as noted above, an additional element of the definition of “small business” is that the entity must be independently owned and operated. The Commission notes that it is difficult at times to assess these criteria in the context of media entities and its estimates of small businesses to which they apply may be over-inclusive to this extent.

Radio Broadcasting. This Economic Census category “comprises establishments primarily engaged in broadcasting aural programs by radio to the public. Programming may originate in their own studio, from an affiliated network, or from external sources.”²¹³ The SBA has established a small business size standard for this category, which is: such firms having \$7 million or less in annual receipts.²¹⁴ According to Commission staff review of BIA Advisory Services, LLC’s *Media Access Pro Radio Database* on March 28, 2012, about 10,759 (97%) of 11,102 commercial radio stations had revenues of \$7 million or less. Therefore, the majority of such entities are small entities.

We note, however, that in assessing whether a business concern qualifies as small under the above size standard, business affiliations must be included.²¹⁵ In addition, to be determined to be a “small business,” the entity may not be dominant in its field of operation.²¹⁶ We note that it is difficult at times to assess these criteria in the context of media entities, and our estimate of small businesses may therefore be over-inclusive.

Auxiliary, Special Broadcast and Other Program Distribution Services. This service involves a variety of transmitters, generally used to relay broadcast programming to the public (through translator and booster stations) or within the program distribution chain (from a remote news gathering unit back to

²¹⁰ *Id.*

²¹¹ *Id.*

²¹² “[Business concerns] are affiliates of each other when one concern controls or has the power to control the other or a third party or parties controls or has the power to control both.” 13 CFR § 21.103(a)(1).

²¹³ U.S. Census Bureau, 2007 NAICS Definitions, “515112 Radio Stations”; <http://www.census.gov/naics/2007/def/ND515112.HTM#N515112>.

²¹⁴ 13 CFR § 121.201, NAICS code 515112 (updated for inflation in 2010).

²¹⁵ “Concerns and entities are affiliates of each other when one controls or has the power to control the other, or a third party or parties controls or has the power to control both. It does not matter whether control is exercised, so long as the power to control exists.” 13 CFR § 121.103(a)(1) (an SBA regulation).

²¹⁶ 13 CFR § 121.102(b) (an SBA regulation).

the station). Neither the SBA nor the Commission has developed a size standard applicable to broadcast auxiliary licensees. The closest applicable SBA category and small business size standard falls under Radio Stations and Television Broadcasting.²¹⁷ U.S. Census Bureau data for 2012 show that 2,849 radio station firms operated during that year.²¹⁸ Of that number, 2,806 firms operated with annual receipts of less than \$25 million per year, 17 with annual receipts between \$25 million and \$49,999,999 million, and 26 with annual receipts of \$50 million or more.²¹⁹ For Television Broadcasting the SBA small business size standard is such businesses having \$38.5 million or less in annual receipts.²²⁰ U.S. Census Bureau data show that 751 firms in this category operated in that year.²²¹ Of that number, 656 had annual receipts of \$25,000,000 or less, 25 had annual receipts between \$25,000,000 and \$49,999,999, and 70 had annual receipts of \$50,000,000 or more.²²² Accordingly, based on the U.S. Census Bureau data for Radio Stations and Television Broadcasting, the Commission estimates that the majority of Auxiliary, Special Broadcast and Other Program Distribution Services firms are small.

The Commission estimates that there are approximately 7,604 FM translators and boosters.²²³ The Commission does not collect financial information on broadcast facilities, and the Department of Commerce does not collect financial information on these auxiliary broadcast facilities. We believe that most, if not all, of these auxiliary facilities could be classified as small businesses by themselves. We also recognize that most commercial translators and boosters are owned by a parent station which, in some cases, would be covered by the revenue definition of a small business entity discussed above. These stations would likely have annual revenues that exceed the SBA maximum to be designated as a small business (\$7.0 million for a radio station or \$14.0 million for a TV station). Furthermore, they do not meet the Small Business Act's definition of a "small business concern" because they are not independently owned and operated.²²⁴

Multichannel Video Distribution and Data Service (MVDDS). MVDDS is a terrestrial fixed microwave service operating in the 12.2-12.7 GHz band. The Commission adopted criteria for defining three groups of small businesses for purposes of determining their eligibility for special provisions such as bidding credits. It defined a very small business as an entity with average annual gross revenues not exceeding \$3 million for the preceding three years; a small business as an entity with average annual gross revenues not exceeding \$15 million for the preceding three years; and an entrepreneur as an entity with average annual gross revenues not exceeding \$40 million for the preceding three years.²²⁵ These

²¹⁷ 13 CFR 121.201, NAICS codes 515112 and 515120.

²¹⁸ U.S. Census Bureau, Table No. EC1251SSSZ4, *Information: Subject Series – Establishment and Firm Size: Receipts Size of Firms for the United States: 2012* NAICS Code 515112, https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ4//naics~515112.

²¹⁹ *Id.*

²²⁰ 13 CFR § 121.201; 2012 NAICS code 515120.

²²¹ U.S. Census Bureau, Table No. EC1251SSSZ4, *Information: Subject Series - Establishment and Firm Size: Receipts Size of Firms for the United States: 2012* (515120 Television Broadcasting). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ4//naics~515120.

²²² *Id.*

²²³ See *FCC News Release*, "Broadcast Station Totals as of March 31, 2018," dated April 9, 2018; <https://docs.fcc.gov/public/attachments/DOC-350110A1.pdf>.

²²⁴ See 15 U.S.C. § 632.

²²⁵ Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range; Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2–12.7 GHz Band by Direct Broadcast Satellite Licensees and their Affiliates; and Applications of Broadwave USA, PDC Broadband Corporation, and Satellite Receivers,

(continued....)

definitions were approved by the SBA.²²⁶ On January 27, 2004, the Commission completed an auction of 214 MVDDS licenses (Auction No. 53). In this auction, ten winning bidders won a total of 192 MVDDS licenses.²²⁷ Eight of the ten winning bidders claimed small business status and won 144 of the licenses. Eight of the ten winning bidders claimed small business status and won 144 of the licenses. The Commission also held an auction of MVDDS licenses on December 7, 2005 (Auction 63). Of the three winning bidders who won 22 licenses, two winning bidders, winning 21 of the licenses, claimed small business status.²²⁸

Amateur Radio Service. These licensees are held by individuals in a noncommercial capacity; these licensees are not small entities.

Personal Radio Services. Personal radio services provide short-range, low-power radio for personal communications, radio signaling, and business communications not provided for in other services. Personal radio services include services operating in spectrum licensed under Part 95 of our rules.²²⁹ These services include Citizen Band Radio Service, General Mobile Radio Service, Radio Control Radio Service, Family Radio Service, Wireless Medical Telemetry Service, Medical Implant Communications Service, Low Power Radio Service, and Multi-Use Radio Service.²³⁰ There are a variety of methods used to license the spectrum in these rule parts, from licensing by rule, to conditioning operation on successful completion of a required test, to site-based licensing, to geographic area licensing. All such entities in this category are wireless, therefore we apply the definition of Wireless Telecommunications Carriers (except Satellite), pursuant to which the SBA's small entity size standard is defined as those entities employing 1,500 or fewer persons.²³¹ For this industry, U.S. Census data for 2012 show that there were 967 firms that operated for the entire year.²³² Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.²³³ Thus, under this category and the associated size standard, the Commission estimates that the majority of firms can be considered small. We note, however, that many of the licensees in this category are individuals and not small entities. In addition, due to the mostly unlicensed and shared nature of the spectrum utilized in many of these

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Ltd. to Provide A Fixed Service in the 12.2–12.7 GHz Band, *Memorandum Opinion and Order and Second Report and Order*, 17 FCC Rcd 9614, 9711, para. 252 (2002).

²²⁶ See Letter from Hector V. Barreto, Administrator, U.S. Small Business Administration, to Margaret W. Wiener, Chief, Auctions and Industry Analysis Division, Wireless Telecommunications Bureau, FCC (Feb. 13, 2002).

²²⁷ See *Multichannel Video Distribution and Data Service Spectrum Auction Closes; Winning Bidders Announced*, Public Notice, 19 FCC Rcd 1834 (2004).

²²⁸ See *Auction of Multichannel Video Distribution and Data Service Licenses Closes; Winning Bidders Announced for Auction No. 63*, Public Notice, 20 FCC Rcd 19807 (2005).

²²⁹ 47 CFR pt. 95.

²³⁰ The Citizens Band Radio Service, General Mobile Radio Service, Radio Control Radio Service, Family Radio Service, Wireless Medical Telemetry Service, Medical Implant Communications Service, Low Power Radio Service, and Multi-Use Radio Service are governed by subpart D, subpart A, subpart C, subpart B, subpart H, subpart I, subpart G, and subpart J, respectively, of Part 95 of the Commission's rules. See generally 47 CFR Part 95.

²³¹ 13 CFR § 121.201, NAICS Code 517312.

²³² U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (Jan. 8, 2016). https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

²³³ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

services, the Commission lacks direct information upon which to base an estimation of the number of small entities that may be affected by our actions in this proceeding.

Public Safety Radio Licensees. As a general matter, Public Safety Radio Pool licensees include police, fire, local government, forestry conservation, highway maintenance, and emergency medical services.²³⁴ Because of the vast array of public safety licensees, the Commission has not developed a small business size standard specifically applicable to public safety licensees. The closest applicable SBA category is Wireless Telecommunications Carriers (except Satellite) which encompasses business entities engaged in radiotelephone communications. The appropriate size standard for this category under SBA rules is that such a business is small if it has 1,500 or fewer employees.²³⁵ For this industry, U.S. Census data for 2012 show that there were 967 firms that operated for the entire year.²³⁶ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.²³⁷ Thus, under this category and the associated size standard, the Commission estimates that the majority of firms can be considered small. With respect to local governments, in particular, since many governmental entities comprise the licensees for these services, we include under public safety services the number of government entities affected. According to Commission records, there are a total of approximately 133,870 licenses within these services.²³⁸ There are 3,121 licenses in the 4.9 GHz band, based on an FCC Universal Licensing System search of March 29, 2017.²³⁹ We estimate that fewer than 2,442 public safety radio licensees hold these licenses because certain entities may have multiple licenses.

IMTS Resale Carriers. Neither the SBA nor the Commission has developed a size standard specifically applicable to IMTS Resale Carriers. Providers of IMTS resale services are common carriers that purchase IMTS from other carriers and resell it to their own customers. The closest applicable SBA category and size standard is for Telecommunications Resellers.²⁴⁰ Under that size standard, such a business is small if

²³⁴ See subparts A and B of Part 90 of the Commission's Rules, 47 CFR §§ 90.1-90.22. Police licensees serve state, county, and municipal enforcement through telephony (voice), telegraphy (code), and teletype and facsimile (printed material). Fire licensees are comprised of private volunteer or professional fire companies, as well as units under governmental control. Public Safety Radio Pool licensees also include state, county, or municipal entities that use radio for official purposes. State departments of conservation and private forest organizations comprise forestry service licensees that set up communications networks among fire lookout towers and ground crews. State and local governments are highway maintenance licensees that provide emergency and routine communications to aid other public safety services to keep main roads safe for vehicular traffic. Emergency medical licensees use these channels for emergency medical service communications related to the delivery of emergency medical treatment. Additional licensees include medical services, rescue organizations, veterinarians, persons with disabilities, disaster relief organizations, school buses, beach patrols, establishments in isolated areas, communications standby facilities, and emergency repair of public communications facilities.

²³⁵ See 13 CFR § 121.201, NAICS code 517312.

²³⁶ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210 (Jan. 8, 2016), https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5/naics~517210.

²³⁷ *Id.* Available census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

²³⁸ This figure was derived from Commission licensing records as of June 27, 2008. Licensing numbers change on a daily basis. We do not expect this number to be significantly smaller today. This does not indicate the number of licensees, as licensees may hold multiple licenses. There is no information currently available about the number of public safety licensees that have less than 1,500 employees.

²³⁹ Based on an FCC Universal Licensing System search of March 29, 2017. Search parameters: Radio Service = PA – Public Safety 4940-4990 MHz Band; Authorization Type = Regular; Status = Active.

²⁴⁰ 13 CFR § 121.201, NAICS code 517911.

it has 1,500 or fewer employees.²⁴¹ U.S. Census Bureau data for 2012 show that 1,341 firms provided resale services during that year.²⁴² Of that number, all operated with fewer than 1000 employees.²⁴³ Thus, under this category and the associated small business size standard, the majority of IMTS resellers can be considered small entities.

Included among the providers of IMTS resale are a number of wireless carriers that also provide wireless telephony services domestically. The Commission classifies these entities as providers of Commercial Mobile Radio Services (CMRS). At present, most, if not all, providers of CMRS that offer IMTS provide such service by purchasing IMTS from other carriers to resell it to their customers. The Commission has not developed a size standard specifically for CMRS providers that offer resale IMTS. For those services subject to auctions, the Commission notes that, as a general matter, the number of winning bidders that qualify as small businesses at the close of an auction does not necessarily represent the number of small businesses currently in service. Also, the Commission does not generally track subsequent business size unless, in the context of assignments or transfers, unjust enrichment issues are implicated.

Wireless Carriers and Service Providers. Neither the SBA nor the Commission has developed a size standard specifically applicable to Wireless Carriers and Service Providers. The closest applicable SBA category and size standard is for Wireless Telecommunications Carriers (except Satellite), which is an entity employing no more than 1,500 persons.²⁴⁴ For this industry, U.S. Census Bureau data for 2012 show that there were 967 firms that operated for the entire year.²⁴⁵ Of this total, 955 firms had employment of 999 or fewer employees and 12 had employment of 1000 employees or more.²⁴⁶ Thus under this category and the associated size standard, the Commission estimates that the majority of Wireless Carriers and Service Providers are small entities.

According to internally developed Commission data for all classes of Wireless Service Providers, there are 970 carriers that reported they were engaged in the provision of wireless services.²⁴⁷ Of this total, an estimated 815 have 1,500 or fewer employees, and 155 have more than 1,500 employees.²⁴⁸ Thus, using available data, we estimate that the majority of Wireless Carriers and Service Providers can be considered small.

²⁴¹ *Id.*

²⁴² See U.S. Census Bureau, *2012 Economic Census of the United States*, Table No. EC1251SSSZ5, *Information: Subject Series - Estab & Firm Size: Employment Size of Firms: 2012* (517911 Telecommunications Resellers), https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5//naics~517911.

²⁴³ *Id.*

²⁴⁴ 13 CFR § 121.201, NAICS codes 517210.

²⁴⁵ U.S. Census Bureau, *2012 Economic Census of the United States*, Table EC1251SSSZ5, *Information: Subject Series: Estab and Firm Size: Employment Size of Firms for the U.S.: 2012 NAICS Code 517210*, https://factfinder.census.gov/bkmk/table/1.0/en/ECN/2012_US/51SSSZ5//naics~517210.

²⁴⁶ *Id.* Available census data does not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with “1000 employees or more.”

²⁴⁷ See Federal Communications Commission, Wireline Competition Bureau, Industry Analysis and Technology Division, Trends in Telephone Service at Table 5.3 (Sept. 2010) (*Trends in Telephone Service*), https://apps.fcc.gov/edocs_public/attachmatch/DOC-301823A1.pdf.

²⁴⁸ See *id.*

E. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

The amendments being made in this Second Report and Order do not change reporting requirements but may require additional training consistent with industry RF safety program standards regarding compliance with our RF exposure limits for certain transmitting facilities, such as broadcast sites, some wireless base stations, and some antennas at multiple transmitter sites. Also, we are clarifying that in order for the occupational/controlled SAR or MPE limits to be used in evaluating compliance for a portable or mobile device, certain conditions must be met that may include placing a visual advisory such as a label on a device that provides a user with specific information on RF exposure. We are also requiring a sample of the advisory and instructional material be filed with the Commission along with the application for equipment authorization.

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

The RFA requires an agency to describe any significant alternatives that it has considered in developing its approach, which may include the following four alternatives (among others): “(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.”²⁴⁹

Report to Congress: The Commission will send a copy of the Second Report and Order, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act.²⁵⁰ In addition, the Commission will send a copy of the Second Report and Order, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the Second Report and Order and FRFA (or summaries thereof) will also be published in the Federal Register.²⁵¹

²⁴⁹ 5 U.S.C. § 603(c).

²⁵⁰ See 5 U.S.C. § 801(a)(1)(A).

²⁵¹ See 5 U.S.C. § 604(b).

APPENDIX E**List of Commenters to
2013 RF Order and Further Notice¹****COMMENTS**

- (1) American Radio Relay League (ARRL)
- (2) B. Blake Levitt & Henry C. Lai (Levitt/Lai)
- (3) Benjamin Walters on Behalf of City of Portland (Portland)
- (4) Blooston, Mordkofsky, Dickens, Duffy & Prendergast for Part 90 licensees (Private Users)
- (5) Cardiac Rhythm Management Device Committee of the AAMI (AAMI-CRMD)
- (6) Cohen, Dippell and Everist, P.C. (CDE)
- (7) Consumer Electronics Association (CEA)
- (8) Consumers for Safe Cell Phones (CSCP)
- (9) CTIA – The Wireless Association (CTIA)
- (10) David Hubert (Hubert)
- (11) EMF Safety Network
- (12) Fixed Wireless Communications Coalition, Inc. (FWCC)
- (13) Hammett & Edison (H&E)
- (14) International Brotherhood of Electrical Workers (IBEW)
- (15) International Committee on Electromagnetic Safety of the IEEE (IEEE-ICES)
- (16) James Edwin Whedbee (Whedbee)
- (17) Mark Douglas on Behalf of IT’IS Foundation (IT’IS Foundation)
- (18) Marv Wessel on Behalf of Global RF Solutions (Wessel)
- (19) Medtronic, Inc. (Medtronic)
- (20) Mobile Manufacturers Forum (MMF)
- (21) Motorola Solutions, Inc. (Motorola)
- (22) National Association of Broadcasters (NAB)
- (23) Nickolaus E. Leggett (Leggett)
- (24) Nokia Corporation (Nokia)
- (25) PCIA – The Wireless Infrastructure Association and The HetNet Forum (PCIA)
- (26) RF Check, Inc. (RF Check)
- (27) Richard A. Tell (Tell)
- (28) Robert Johnson on Behalf of Narda-East (Narda)
- (29) Site Safe, Inc. (SiteSafe)
- (30) Telecommunications Industry Association (TIA)
- (31) The EMRadiation Policy Institute (EMRPI)
- (32) Utilities Telecom Council (UTC)
- (33) Verizon and Verizon Wireless (Verizon)
- (34) Wi-Fi Alliance

REPLY COMMENTS

- (1) Alarm Industry Communications Committee (AICC)
- (2) AT&T Services Inc. (AT&T)
- (3) City of Boston, Massachusetts and City of Philadelphia, Pennsylvania (Boston & Philadelphia)

¹ Five-hundred sixty-four commenters responded to the request for comment in Notice of Inquiry that accompanied the Report and Order and Further Notice, the bulk of which were brief comments or submissions of redundantly filed studies, reports and other publications reviewed in the Inquiry.

- (4) CTIA – The Wireless Association (CTIA)
- (5) Hammett & Edison (H&E)
- (6) PCIA – The Wireless Infrastructure Association and The HetNet Forum (PCIA)
- (7) Qualcomm Incorporated (Qualcomm)
- (8) Site Safe, Inc. (SiteSafe)
- (9) The EMRadiation Policy Institute (EMRPI)
- (10) Utilities Telecom Council (UTC)
- (11) Verizon and Verizon Wireless (Verizon)
- (12) Wi-Fi Alliance

EX PARTE & LATE-FILED COMMENTS

- (1) CTIA-The Wireless Association (CTIA)
- (2) Hewlett-Packard Company (HP)
- (3) Occupational Safety and Health Administration (OSHA)
- (4) RF Check, Inc. (RF Check)
- (5) Telecommunications Industry Association (TIA)
- (6) Verizon and Verizon Wireless (Verizon)