

**FCC FACT SHEET\*****Amendment of Parts 15 and 74 of the Rules for Wireless Microphones in the TV Bands, 600 MHz Guard Band, 600 MHz Duplex Gap, and the 941.5-944 MHz, 944-952 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz, 1435-1525 MHz, 6875-6900 MHz and 7100-7125 MHz Bands**

Report and Order – ET Docket No. 21-115

**Background:** Wireless microphones are permitted to operate on a licensed basis under Part 74 of the Commission’s rules in a number of frequency bands—including the TV bands, a 4-megahertz portion of the 600 MHz duplex gap, and in the 900 MHz, 1.4 GHz, and 7 GHz bands. They also may operate on an unlicensed basis under Part 15 of the Commission’s rules in the TV bands, a 2-megahertz portion of the 600 MHz guard band and in the upper 6-megahertz portion of the 600 MHz duplex gap where use is shared with unlicensed white space devices. Recently, a new wireless microphone technology has emerged—“Wireless Multi-Channel Audio System” (WMAS)—which operates with a wider bandwidth than the Commission’s rules currently allow and would enable more wireless microphones to operate in the spectrum available (i.e., more microphones per megahertz of spectrum). WMAS already is permitted in Europe under the applicable European Telecommunications Standards Institute (ETSI) standards. The Report and Order aims to enhance wireless microphone spectral efficiency. It is not intended to alter the existing spectrum rights—or expectations regarding access and availability of spectrum—vis-à-vis other authorized users (e.g., broadcast licensees, white space device users, the wireless microphone users themselves, or others) that share use of the frequency bands with wireless microphone operations.

**What the Report and Order Would Do:**

- Permit licensed wireless microphone users to operate WMAS on frequencies already available for Part 74 licensed wireless microphones in the TV bands (VHF and UHF), the 653-657 MHz segment of the 600 MHz duplex gap, and in the 941.5-944 MHz, 944-952 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz, 1435-1525 MHz, 6875-6900 MHz and 7100-7125 MHz bands.
- Permit WMAS operating under Part 74 to use up to 6 megahertz channels in the TV bands, up to a 4 megahertz channel in the 600 MHz duplex gap, and up to 20 MHz channels in other bands, but allow smaller channels when less spectrum is available in a band or is sufficient for an application.
- Permit unlicensed wireless microphone users to operate WMAS on frequencies already available for Part 15 unlicensed wireless microphones in the UHF and VHF TV bands and in the 657-663 MHz segment of the 600 MHz duplex gap with up to 6 megahertz channels, but allow smaller channels.
- Require Part 15 and 74 WMAS to be capable of operating with at least three audio channels per megahertz of spectrum to ensure that spectrum is used efficiently.
- Require Part 15 and 74 WMAS to comply with the emission mask and spurious emission limits for WMAS specified in the 2021 ETSI wireless microphones standard.
- Update the existing Part 74 and Part 15 wireless microphone technical rules to reference relevant portions of the 2021 ETSI wireless microphone standard (current rules reference the 2011 version).

\* This document is being released as part of a “permit-but-disclose” proceeding. Any presentations or views on the subject expressed to the Commission or its staff, including by email, must be filed in ET Docket No. 21-115, which may be accessed via the Electronic Comment Filing System (<https://www.fcc.gov/ecfs/>). Before filing, participants should familiarize themselves with the Commission’s *ex parte* rules, including the general prohibition on presentations (written and oral) on matters listed on the Sunshine Agenda, which is typically released a week prior to the Commission’s meeting. See 47 CFR § 1.1200 *et seq.*

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

In the Matter of )
)
Amendment of Parts 15 and 74 of the Rules for ) ET Docket No. 21-115
Wireless Microphones in the TV Bands, 600 MHz )
Guard Band, 600 MHz Duplex Gap, and the 941.5- ) RM-11821
944 MHz, 944-952 MHz, 952.850-956.250 MHz, )
956.45-959.85 MHz, 1435-1525 MHz, 6875-6900 )
MHz and 7100-7125 MHz Bands )
)

REPORT AND ORDER\*

Adopted: "Insert Adopted Date"

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\* This document has been circulated for tentative consideration by the Commission at its February 15, 2024 open meeting. The issues referenced in this document and the Commission’s ultimate resolution of those issues remain under consideration and subject to change. This document does not constitute any official action by the Commission. However, the Chairwoman has determined that, in the interest of promoting the public’s ability to understand the nature and scope of issues under consideration, the public interest would be served by making this document publicly available. The FCC’s ex parte rules apply and presentations are subject to “permit-but-disclose” ex parte rules. See, e.g., 47 CFR §§ 1.1206, 1.1200(a). Participants in this proceeding should familiarize themselves with the Commission’s ex parte rules, including the general prohibition on presentations (written and oral) on matters listed on the Sunshine Agenda, which is typically released a week prior to the Commission’s meeting. See 47 CFR §§ 1.1200(a), 1.1203.

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## I. INTRODUCTION

1. In this Report and Order, we revise the technical rules for Part 74 low-power auxiliary station (LPAS) devices to permit a recently developed type of wireless microphone system,<sup>1</sup> termed herein as a Wireless Multichannel Audio System (WMAS), to operate in the broadcast television (TV) bands and other Part 74 LPAS frequency bands on a licensed basis. Wireless microphones play a vital role in the entertainment and news industries as well as at educational institutions, houses of worship, conventions and anywhere large numbers of people gather. This emerging technology will enable more wireless microphones to operate in the spectrum available for wireless microphone operations, and thus advance an important Commission goal to promote efficient spectrum use. We adopt technical rules for licensed WMAS operations in specific frequency bands under our Part 74 LPAS rules and also permit WMAS to operate on an unlicensed basis under the Part 15 rules in the TV bands and 600 MHz duplex gap. We update our existing Part 74 LPAS and Part 15 technical rules for wireless microphones, which already rely on certain European Telecommunications Standards Institute (ETSI) standards, to incorporate the latest version of that standard where appropriate.<sup>2</sup> Finally, we update the wireless microphone rules to reflect the end of the post-Incentive Auction transition period. Our goal in this proceeding is to increase wireless microphone spectral efficiency and enable more intensive use in the spectrum available for such operations. We do not intend to alter the existing spectrum rights—or expectations regarding spectrum access and availability—vis-à-vis all the various authorized users, whether broadcast licensees, white space device users, the wireless microphone users themselves, or others, that share frequency bands with wireless microphones.

## II. BACKGROUND

2. Wireless microphones can be found in a variety of settings, including theaters and music venues, TV and film studios, educational institutions, conventions, corporate events, houses of worship, and internet webcasts.<sup>3</sup> Wireless microphone operations range from professional uses, with the need for numerous high-performance microphones, to an individual consumer's use of a handheld microphone at a conference or in a karaoke bar<sup>4</sup> and are authorized for licensed and/or unlicensed operations<sup>5</sup> Most licensed wireless microphones operate under the Part 74 LPAS rules on a secondary basis.<sup>6</sup> Under those rules, they can operate in the VHF-TV and UHF-TV bands in areas outside TV station protected service contours, a 4-megahertz portion of the 600 MHz Service duplex gap, certain frequencies in the 900 MHz

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<sup>1</sup> When we use the term “wireless microphones” in this proceeding, we collectively refer to wireless microphones and related wireless audio devices, such as cue and control communications, synchronization of TV camera signals, and in-ear monitors, as the Commission has in other proceedings concerning these devices. *See, e.g., Promoting Spectrum Access for Wireless Microphone Operations; Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, GN Docket Nos. 14-166, 12-268, Report and Order, 30 FCC Rcd 8739, 8740, para. 1 n.1 (2015) (*Wireless Microphones R&O*).

<sup>2</sup> 47 CFR §§ 74.861, 15.236.

<sup>3</sup> *Promoting Spectrum Access for Wireless Microphone Operations; Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, GN Docket Nos. 14-166, 12-268, Order on Reconsideration and Further Notice of Proposed Rulemaking, 32 FCC Rcd 6077, 6080-81, para. 4 (2017) (*Wireless Microphones Order on Reconsideration*).

<sup>4</sup> *Id.*

<sup>5</sup> *See generally Wireless Microphones Order on Reconsideration*, 32 FCC Rcd at 6080-81, paras. 4-5; *Wireless Microphones R&O*, 30 FCC Rcd at 8742, paras. 5-6.

<sup>6</sup> 47 CFR pt. 74, subpt. H.

band, the 1435-1525 MHz band, and portions of the 7 GHz band.<sup>7</sup> Entities eligible for Part 74 licenses include broadcast station licensees and networks, certain cable television operators, motion picture/TV producers, and professional sound companies and venue operators that routinely use 50 or more wireless microphones.<sup>8</sup> Unlicensed wireless microphones also operate in certain bands under the Part 15 rules, including the TV bands where they generally share the same basic technology used by licensed LPAS wireless microphones, although at a lower power level.<sup>9</sup>

3. Historically and currently, most wireless microphones—both licensed and unlicensed—operate on spectrum in the TV bands not otherwise occupied by a licensed user where they share use of that spectrum with unlicensed white space devices.<sup>10</sup> The spectrum available for these devices has decreased in recent years as a result of the Commission’s actions that repurposed and repacked portions of the TV bands to provide more spectrum for mobile broadband services.<sup>11</sup> In 2015 and 2017, the Commission took several actions focused on promoting more efficient spectrum use by both licensed and unlicensed wireless microphone operations in the repacked TV bands, 600 MHz guard band, and 600 MHz duplex gap, and on making spectrum available in additional frequency bands that can be used to accommodate licensed wireless microphone operations.<sup>12</sup>

4. In 2015, the Commission adopted several changes to ensure sufficient spectrum would continue to be available for wireless microphones following the Incentive Auction and broadcast television band repacking.<sup>13</sup> The Commission revised its rules to provide more opportunities for wireless microphones to access spectrum by allowing greater use of the VHF broadcast television channels and

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<sup>7</sup> 47 CFR § 74.802.

<sup>8</sup> 47 CFR § 74.832.

<sup>9</sup> 47 CFR § 15.236.

<sup>10</sup> Licensed and unlicensed wireless microphones and white space devices can operate on TV channels 2-36 at locations where a channel is unused (i.e., outside protected TV service contours), and unlicensed wireless microphones and white space devices can operate in the upper 6-megahertz portion of the 600 MHz duplex gap. 47 CFR §§ 74.802(a); 15.236(c); 15.707. Licensed wireless microphone users can register TV channel usage in the white space database, and white space devices must avoid operating on TV channels at those registered times and locations. *Id.* § 15.712(f). Unlicensed wireless microphone users must share spectrum in the TV bands and the upper 6-megahertz portion of the 600 MHz duplex gap on an equal basis with white space devices. *Id.* § 15.5(b).

<sup>11</sup> *See generally Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, GN Docket No. 12-268, Report and Order, 29 FCC Rcd 6567 (2014) (*Incentive Auction R&O*); *Incentive Auction Closing and Channel Reassignment Public Notice: The Broadcast Television Incentive Auction Closes; Reverse Auction and Forward Auction Results Announced; Final Television Band Channel Assignments Announced; Post-Auction Deadlines Announced*, Public Notice, 32 FCC Rcd 2786 (2017) (*Channel Reassignment Public Notice*). The final 600 MHz band plan repurposed TV channels 38-51 for wireless services, and wireless microphones may now operate only in small portions of the 600 MHz band, specifically, in designated segments of the guard band and duplex gap. 47 CFR § 74.802(a)(2) (permitting licensed wireless microphones to operate in the 653-657 MHz segment of the 600 MHz duplex gap; *id.* § 15.236(c)(3), (5) (permitting unlicensed wireless microphones to operate in the 614-616 MHz segment of the 600 MHz guard band and the 657-663 segment of the 600 MHz duplex gap).

<sup>12</sup> *Wireless Microphones R&O*, 30 FCC Rcd 8739; *Amendment of Part 15 of the Commission’s Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37, and Amendment of Part 74 of the Commission’s Rules for Low Power Auxiliary Stations in the Repurposed 600 MHz Band and 600 MHz Duplex Gap; Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, ET Docket No. 14-165 and GN Docket No. 12-268, Report and Order, 30 FCC Rcd 9551 (2015) (*White Spaces R&O*); *Wireless Microphones Order on Reconsideration*, 32 FCC Rcd 6077.

<sup>13</sup> *See generally Wireless Microphones R&O*, 30 FCC Rcd 8739. In the 2015 *White Spaces R&O*, issued contemporaneously the *Wireless Microphones R&O*, the Commission codified rules for unlicensed wireless microphone operations in the broadcast television bands. *White Spaces R&O*, 30 FCC Rcd at 9554-55, para. 7.

increasing opportunities for co-channel operations with television stations.<sup>14</sup> It expanded eligibility for licensed use of a 4-megahertz portion of the 600 MHz duplex gap to all entities eligible to hold wireless microphone licenses.<sup>15</sup> The Commission also took actions to provide spectrum for wireless microphones outside of the broadcast television band, including portions of the 900 MHz, 1.4 GHz, and 7 GHz bands.<sup>16</sup> In addition, the Commission updated the technical rules, which had been in place since 1987, to require compliance with the then-applicable ETSI standards for emission masks concerning analog and digital wireless microphones, which enabled more efficient use of the available spectrum.<sup>17</sup> The Commission also codified rules for unlicensed wireless microphones that operate in the TV bands, a 2-megahertz portion of the 600 MHz guard band and a 6-megahertz portion of the 600 MHz duplex gap, and required unlicensed wireless microphones to comply with the same ETSI emission masks as licensed wireless microphones.<sup>18</sup>

5. In 2017, in the *Wireless Microphones Order on Reconsideration*, the Commission furthered its goal of promoting wireless microphone operations and ensuring sufficient spectrum would be available following the Incentive Auction and repacking process.<sup>19</sup> Specifically, it made technical revisions to rules it had adopted in 2015 for both licensed and unlicensed wireless microphone operations in the TV bands and in the 600 MHz guard band and duplex gap, as well as for licensed wireless microphone operations in several frequency bands outside of the TV bands.<sup>20</sup> These technical revisions included adoption of additional ETSI standards regarding spurious emission limits that apply to wireless microphones.<sup>21</sup>

6. *Notice of Proposed Rulemaking.* On April 22, 2021, the Commission adopted a *Notice of Proposed Rulemaking* that proposed to revise the technical rules for Part 74 LPAS devices to permit a recently developed type of wireless microphone system, termed a Wireless Multichannel Audio System

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<sup>14</sup> *Wireless Microphones R&O*, 30 FCC Rcd at 8744, para. 11.

<sup>15</sup> *Id.*

<sup>16</sup> *Wireless Microphones R&O*, 30 FCC Rcd at 8744, para. 11. Specifically, the Commission adopted revisions to provide new opportunities for wireless microphone operations in the 169-172 MHz band and the 944-952 MHz band, and allow use in several other spectrum bands – the 941-944 MHz and 952-960 MHz bands (on each side of the 944-952 MHz band), the 1435-1525 MHz band, and portions of the 6875-7125 MHz band – for licensed wireless microphone operations under specified conditions. *Id.*

<sup>17</sup> *Wireless Microphones R&O*, 30 FCC Rcd at 8752-53, paras. 29-32. Specifically, the Commission required that emissions from analog and digital unlicensed wireless microphones comply with the emission masks in Section 8.3 of ETSI EN 300 422-1 v1.4.2 (2011-08), *Electromagnetic compatibility and Radio spectrum Matters (ERM); Wireless microphones in the 25 MHz to 3 GHz frequency range; Part 1: Technical characteristics and methods of measurement* (EN 300 422-1 (2011)). *Id.* at 8753, para. 32.

<sup>18</sup> *White Spaces R&O*, 30 FCC Rcd at 9588-9590, paras. 95-101.

<sup>19</sup> *Wireless Microphones Order on Reconsideration*, 32 FCC Rcd at 6079-80, para. 2.

<sup>20</sup> *Id.* at 6079-70, para. 2. In the Further Notice of Proposed Rulemaking, the Commission proposed to permit certain professional theater, music, performing arts, and similar organizations that currently operate wireless microphones on an unlicensed basis to obtain licenses to operate in the broadcast television bands and other frequency bands available under the Part 74 LPAS rules. *Id.* at 6119, para. 77. That proposal remains pending before the Commission.

<sup>21</sup> *Wireless Microphones Order on Reconsideration*, 32 FCC Rcd at 6083-88, paras. 9-16. Specifically, the Commission required that emissions more than one megahertz above and below a wireless microphone carrier frequency (i.e., outside the defined ETSI mask) must comply with the limits in Section 8.4 of ETSI EN 300 422-1 (2011). *Id.* at 6085-86, para. 13.

(WMAS), to operate in the TV bands and other Part 74 LPAS frequency bands on a licensed basis.<sup>22</sup> This emerging technology will enable more wireless microphones to operate in the spectrum available for wireless microphone operations (i.e., more microphones per megahertz of spectrum), and thus advance an important Commission goal to promote more efficient spectrum use. The *Notice* proposed and sought comment on the definition of WMAS,<sup>23</sup> proposed to allow WMAS to operate in many of the bands where Part 74 LPAS wireless microphones are currently permitted to operate (i.e., those bands large enough to accommodate WMAS),<sup>24</sup> and proposed and sought comment on technical requirements for WMAS devices.<sup>25</sup> The *Notice* also proposed to make other technical updates to the wireless microphone rules to reflect the end of the post-Incentive Auction transition and to incorporate applicable portions of the 2017 version of the ETSI wireless microphone standard.<sup>26</sup> The *Notice* also sought comment on whether the Commission should allow WMAS to operate on an unlicensed basis under Part 15 of the rules, and if so, in which specific bands and under what technical requirements.<sup>27</sup>

7. Ten parties filed comments and nine parties filed reply comments in response to the *Notice*. Commenters generally support modifying the Part 74 rules to allow WMAS, citing improved spectral efficiency.<sup>28</sup> No parties specifically object to allowing WMAS, but there is disagreement on a number of technical and operational issues, including which parties should be eligible to operate WMAS, the bands where WMAS should be permitted to operate, and the appropriate power, bandwidth, and spectral efficiency requirements.

### III. DISCUSSION

8. We amend the Part 74 LPAS technical rules to permit the use of WMAS in most of the frequency bands where wireless microphones are currently permitted to operate. WMAS devices use wider channelization than currently is permitted for wireless microphones under Part 74, along with a more efficient operating protocol, that can enable more microphones to be deployed within the same amount of spectrum.<sup>29</sup> Specifically, we adopt a definition of WMAS and specify the frequency bands in which WMAS will be permitted, along with the technical requirements (spectral efficiency, channel bandwidth, maximum output power, and emission masks) that govern the operation of these systems on a licensed basis under part 74. We adopt technical rules for WMAS consistent with the recently updated, i.e., 2021, ETSI standard for WMAS. We also update our existing technical rules for currently authorized Part 74 LPAS wireless microphones, which already rely on certain ETSI standards, to incorporate the applicable portions of the 2021 ETSI standard for WMAS. In addition, we revise the Part 15 technical rules for unlicensed wireless microphone devices that operate in the TV bands and the 600 MHz duplex gap to permit WMAS operations in those bands and to require use of the 2021 ETSI standard. Finally, we make minor updates to the Part 15 and Part 74 rules to reflect the end of the post-Incentive Auction

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<sup>22</sup> *Amendment of Parts 15 and 74 of the Rules for Wireless Microphones in the TV Bands, 600 MHz Guard Band, 600 MHz Duplex Gap, and the 941.5-944 MHz, 944-952 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz, 1435-1525 MHz, 6875-6900 MHz and 7100-7125 MHz Bands*, ET Docket No. 21-115, RM-11821, Notice of Proposed Rulemaking, 36 FCC Rcd 7908 (2021) (*Notice*).

<sup>23</sup> *Notice*, 36 FCC Rcd at 7914-15, para. 11.

<sup>24</sup> *Notice*, 36 FCC Rcd at 7915, para. 13.

<sup>25</sup> *Notice*, 36 FCC Rcd at 7914-15, 7916-23, paras. 11, 16-34.

<sup>26</sup> *Notice*, 36 FCC Rcd at 7928-29, paras. 51-52.

<sup>27</sup> *Notice*, 36 FCC Rcd at 7926, paras. 44-45.

<sup>28</sup> Sennheiser Comments at 2; Shure Comments at 2; Waves Comments at 3; NAB Comments at 2; Lectrosonics Reply at 1.

<sup>29</sup> *Notice*, 36 FCC Rcd at 7913, para. 9.

transition.<sup>30</sup>

9. At the time the Commission released the *Notice*, the latest ETSI standard for wireless microphones was the version released in 2017, but the Commission noted the possibility that ETSI could further update its standard during the pendency of this proceeding.<sup>31</sup> The standard was updated in November 2021 after we released the NPRM. In assessing the changes between the 2017 and 2021 versions, we find that none of the changes affecting the parts of the standard that pertain to this proceeding were of a substantive nature; thus, the changes between the two versions do not affect the overall proposals or the nature of the record. Consistent with our current practice regarding the ETSI wireless microphone standard, we will continue to reference only specific portions in our rules, i.e., the transmit emission masks and spurious emission limits. As noted, we find that there are no significant differences between the 2017 and 2021 ETSI standards in that regard.<sup>32</sup> Several parties recognize the pending update to the ETSI standard in their comments and explicitly support adoption of the 2021 version.<sup>33</sup>

## A. Revisions to the Part 74 LPAS Rules to Authorize WMAS

### 1. Definition of WMAS

10. *Background.* In the *Notice*, the Commission proposed to adopt the terminology and definition suggested by Sennheiser for the new type of wireless microphone device.<sup>34</sup> Specifically, Sennheiser suggests that the Commission use the term “Wireless Multichannel Audio System” and to broadly define this system as “[a] system that digitally combines the signals of multiple low power auxiliary station devices onto one radio-frequency channel.”<sup>35</sup> The Commission noted that the most recent version of the ETSI standard at the time (the 2017 version) used the same name for these types of systems, although it did have a slightly different definition, namely “wireless audio transmission systems using broadband transmission technique for microphone and in-ear monitor systems, and other multichannel audio [Programme Making and Special Events] use.”<sup>36</sup>

11. Microsoft supports the ETSI definition of WMAS, arguing that ETSI intends WMAS for more demanding audio performance requirements, and its definition identifies the high-performance

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<sup>30</sup> The 39-month transition period ran from April 13, 2017, to July 13, 2020. *Channel Reassignment Public Notice*, 32 FCC Rcd at 2807, para. 68. After the transition, wireless microphones, both licensed and unlicensed, are no longer permitted to operate in the 600 MHz service bands (617-652 MHz and 663-698 MHz). *Incentive Auction R&O*, 29 FCC Rcd at 6846, para. 687.

<sup>31</sup> *Notice*, 36 FCC Rcd at 7922, para. 31.

<sup>32</sup> 47 CFR §§ 74.861(d)(4), (e)(7), 15.236(g).

<sup>33</sup> Sennheiser Comments at 7; Shure Comments at 24-25.

<sup>34</sup> *Notice*, 36 FCC Rcd at 7914, para. 11.

<sup>35</sup> Sennheiser Electronic Corporation Request for Amendment of Part 74 of the Commission’s Rules to Advance the Use of Spectrum Efficient Wireless Microphone Equipment, RM-11821 at 7, 9 (filed Aug. 17, 2018), <https://www.fcc.gov/ecfs/document/108170272204061/1>.

<sup>36</sup> *Notice*, 36 FCC Rcd at 7914, para. 10. European Telecommunications Standards Institute ETSI EN 300 422-1 v2.1.2 (2017-01), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Class A Receivers; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU*, [https://www.etsi.org/deliver/etsi\\_en/300400\\_300499/30042201/02.01.02\\_60/en\\_30042201v020102p.pdf](https://www.etsi.org/deliver/etsi_en/300400_300499/30042201/02.01.02_60/en_30042201v020102p.pdf), Section 3.1, at 15 [ETSI EN 300 422-1 (2017)]. Programme Making and Special Events (PMSE) covers a wide range of equipment, including radio microphones, in-ear monitors, video and audio links and associated equipment such as talkback and assistive listening devices and low-cost license-exempt consumer radio microphones, as well as audio systems used by tour guides. See <https://www.etsi.org/technologies/pmse>. “Audio PMSE” is defined by ETSI as an “inclusive description consisting of radio microphones, in ear monitoring systems, [and] audio links.” ETSI EN 300 422-1 (2017), Section 3.1 at 13.

audio systems (wireless microphones, in-ear monitoring systems, and audio links) that would operate using WMAS.<sup>37</sup> Microsoft also prefers the definition in the 2017 ETSI standard over the Commission’s proposed definition because the ETSI definition requires that WMAS use broadband transmission techniques rather than generic ‘digital techniques’ as proposed by Sennheiser, which it views as too broad to hold any meaning.<sup>38</sup> Shure supports a WMAS definition similar to the ETSI definition because it will encompass wireless audio devices that are classified as Part 74 devices as well as those that are classified as Part 15 devices.<sup>39</sup> ETSI subsequently made several minor additions to the WMAS definition in the 2021 version of its standard (shown in underline below), which now defines WMAS as: “wireless audio transmission systems using digital broadband transmission techniques for microphone and in-ear monitor systems applications, and other multichannel audio PMSE use, e.g. with the ability to support three or more audio channels per MHz.”<sup>40</sup>

12. *Discussion.* We adopt the WMAS definition in the 2021 ETSI standard, with two modifications. We do not include the term “PMSE” (Programme Making and Special Events), which is not used in the Commission rules and is not needed because the Part 74 rules already define the device categories to which the rules apply (Low Power Auxiliary Stations).<sup>41</sup> We also do not include the phrase concerning “the ability [of WMAS] to support three or more audio channels per MHz” since that is listed merely as an example in the definition, but we separately specify a similar spectral efficiency requirement in the rules. Accordingly, for purposes of parts 15 and 74, we define “Wireless Multichannel Audio Systems” as “[w]ireless audio transmission systems using broadband digital transmission techniques for microphone and in-ear monitor system applications and other multichannel audio use.” We believe that this definition will encompass the types of WMAS devices that Sennheiser and others are developing, and is consistent with Microsoft’s and Shure’s requests to adopt a WMAS definition similar to ETSI’s definition.

## 2. Frequency Bands of Operation

13. *Background.* The Commission proposed to allow WMAS to operate in most of the frequency bands where Part 74 wireless microphones are permitted to operate, including the VHF-TV bands (54-72 MHz, 76-88 MHz, and 174-216 MHz), the UHF-TV band (470-608 MHz), the 653-657 MHz segment of the 600 MHz duplex gap, and the 941.5-944 MHz, 944-952 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz, 1435-1525 MHz, 6875-6900 MHz, and 7100-7125 MHz bands.<sup>42</sup> These are all of the frequency bands available for LPAS operations in which the Commission believed that wireless microphones using a wider channelization system are technically feasible and thus could enable more efficient use of the limited spectrum available for wireless microphone operations.<sup>43</sup> The Commission did not propose to allow WMAS operation in the 26.100-26.480 MHz, 161.625-161.775 MHz, 450.000-451.000 MHz and 455.000-456.000 MHz bands because it believed that the available spectrum in those

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<sup>37</sup> Microsoft Comments at 6.

<sup>38</sup> *Id.*

<sup>39</sup> Shure Comments at 3.

<sup>40</sup> European Telecommunications Standards Institute ETSI EN 300 422-1 v2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum*, [https://www.etsi.org/deliver/etsi\\_en/300400\\_300499/30042201/02.02.01\\_60/en\\_30042201v020201p.pdf](https://www.etsi.org/deliver/etsi_en/300400_300499/30042201/02.02.01_60/en_30042201v020201p.pdf), Section 3.1, at 14 [ETSI EN 300 422-1 (2021)]. This standard, as with the previous ETSI standard incorporated into the Part 15 and Part 74 rules, is publicly available at no charge.

<sup>41</sup> 47 CFR § 74.801.

<sup>42</sup> *Notice*, 36 FCC Red at 7915, para. 13.

<sup>43</sup> *Id.*



bands (1 megahertz or less) makes them less suited for WMAS operation.<sup>44</sup>

14. Wireless microphone manufacturers support allowing WMAS operation in the proposed Part 74 LPAS bands,<sup>45</sup> but other parties ask the Commission to prohibit the operation of some or all types of wireless microphone in certain bands. Several parties object to allowing WMAS in the 6875-6900 MHz and 7100-7125 MHz bands. These parties express concern that WMAS operations in these bands could negatively impact unlicensed devices and note that WMAS operating on a licensed basis under Part 74 would have priority over unlicensed devices.<sup>46</sup> They recommend that WMAS not be permitted to operate in the 6875-6900 MHz and 7100-7125 MHz bands, or, if allowed, that their power level be limited to reduce the potential for interference.<sup>47</sup> Furthermore, Microsoft and Cisco/Facebook suggest that the Commission remove the 6875-6900 MHz and 7100-7125 MHz bands from the list of frequencies available for Part 74 LPAS use, which would make them no longer available for narrowband wireless microphones as well, stating that while there is currently little use of wireless microphones in these bands and the operating range of wireless microphones in them is short, retaining the bands on the list of available frequencies creates regulatory uncertainty.<sup>48</sup> In addition, ViacomCBS is concerned about WMAS reducing spectrum availability for broadcasters using narrowband wireless microphones and believes that WMAS should either be prohibited from operating in the UHF-TV band, or, if allowed, should be secondary to narrowband wireless microphones.<sup>49</sup>

15. *Discussion.* We permit WMAS to operate on a licensed basis in all of the bands we proposed in the *Notice*, specifically, the VHF-TV bands (54-72 MHz, 76-88 MHz, and 174-216 MHz), the UHF-TV band (470-608 MHz), the 653-657 MHz segment of the 600 MHz duplex gap, and the 941.5-944 MHz, 944-952 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz, 1435-1525 MHz, 6875-6900 MHz, and 7100-7125 MHz bands.<sup>50</sup> Several of these bands, including the TV bands, allow for WMAS channel sizes of 6 megahertz or greater, while the smaller bands (the 653-657 MHz segment of the duplex gap, the 952.850-956.250 MHz band, and the 956.45-959.85 MHz) each contain three to four megahertz of spectrum.<sup>51</sup> While Sennheiser argues that WMAS works best with at least 6 megahertz of spectrum, it and other parties indicate that WMAS can work with a lesser amount.<sup>52</sup>

16. We disagree that we should prohibit either WMAS or the types of wireless microphones currently permitted under Part 74 from operating in the 6875-6900 MHz and 7100-7125 MHz bands that are available for use by low power indoor Unlicensed National Information Infrastructure (U-NII) devices under Part 15 of the rules.<sup>53</sup> The Commission first permitted licensed wireless microphones to use these bands in the 2015 *Wireless Microphones R&O*, which was intended to accommodate the future needs of

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<sup>44</sup> *Id.*

<sup>45</sup> Sennheiser Comments at 1; Shure Comments at 8; Waves Audio Comments at 3; Lectrosonics Reply at 2.

<sup>46</sup> Cisco/Facebook Comments at 14-16; Wi-Fi Alliance Comments at 1; Cisco/Facebook/Qualcomm/Intel Reply at 9; NCTA Reply at 1-2.

<sup>47</sup> Cisco/Facebook Comments at 14-16; Wi-Fi Alliance Comments at 1; Cisco/Facebook/Qualcomm/Intel Reply at 9; NCTA Reply at 1-2.

<sup>48</sup> Microsoft Comments at 7-8; Cisco/Facebook Comments at 4, 11-12.

<sup>49</sup> Viacom/CBS Reply at 6-7.

<sup>50</sup> *Notice*, 36 FCC Red at 7915, para. 13.

<sup>51</sup> The 941.5-944 MHz band is only 2.5 megahertz wide, but it is immediately adjacent to the 944-952 MHz band and could be combined with it.

<sup>52</sup> Sennheiser Comments at 7; Waves Audio Comments at 6; Lectrosonics Reply at 4; Shure Reply at 19. Sennheiser states that WMAS technology is possible for bandwidths smaller than 6 MHz, but it quickly loses its advantages over conventional wireless microphone operations due to channel fading effects. Sennheiser Comments at 7.

<sup>53</sup> 47 CFR §§ 15.401-15.407. That portion of the 6 GHz (6875-7125 MHz) band is designated as the U-NII-8 band.

wireless microphones by making additional spectrum available where they could operate.<sup>54</sup> Some parties now argue that the 6875-6900 MHz and 7100-7125 MHz bands should be removed from the list of frequencies available for licensed wireless microphone operations because the bands are not heavily used by wireless microphones at this time, retaining these bands creates regulatory uncertainty, and wireless microphones operating at these frequencies may have limited range as compared to wireless microphones in other bands.<sup>55</sup> However, such a decision is beyond the scope of this order as the Commission did not seek comment in the *Notice* on the removal of the 6875-6900 MHz and 7100-7125 MHz bands from the list of bands available for Part 74 wireless microphones.<sup>56</sup> In any event, we do not believe that the relatively low current usage of these bands is a reason to remove them since they provide 50 megahertz of spectrum that could accommodate licensed wireless microphones at locations where additional spectrum capacity for microphones may be needed.

17. Moreover, other parties express concern that WMAS operations in the 6875-6900 MHz and 7100-7125 MHz bands could negatively impact unlicensed devices and recommend that WMAS not be permitted to operate in those bands or that the WMAS power level be limited to reduce the potential for harmful interference. Because the Commission established rules for licensed wireless microphones in these bands prior to the 2020 *6 GHz Report and Order* that established rules for unlicensed devices in these bands, parties developing or operating unlicensed devices were already aware that they will have to share spectrum with licensed wireless microphones operating at power levels up to one watt.<sup>57</sup> Allowing WMAS to operate in the 6875-6900 MHz and 7100-7125 MHz bands in addition to the Part 74 wireless microphones currently permitted will not negatively impact unlicensed operations as some parties suggest. As discussed below, WMAS must comply with the same power limit as other Part 74 wireless microphones in the 6875-6900 MHz and 7100-7125 MHz bands, i.e., one watt, but we are establishing a wider 20-megahertz maximum allowable bandwidth for WMAS. Therefore, WMAS power spectral density (PSD) in these bands will be lower than that permitted by the current rules, so the interference potential of WMAS to unlicensed devices will be lower than current wireless microphones. Further, as parties noted, the wireless microphone operating range in the 6875-6900 MHz and 7100-7125 MHz bands is short, which means that the distance at which unlicensed devices could potentially receive harmful interference from them is also short.<sup>58</sup> And finally, we note that unlicensed 6 GHz devices in that band are limited to low-power-indoor devices. These devices are required to incorporate a contention-based protocol that will help promote co-existence with other band users, including wireless microphone users.<sup>59</sup> For these reasons, we disagree that our decision to permit WMAS and other Part 74 wireless microphones to operate in the 6875-6900 MHz and 7100-7125 MHz bands will create regulatory uncertainty for manufacturers and users of unlicensed devices in these bands.

18. We disagree with ViacomCBS that we should prohibit WMAS from operating in the

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<sup>54</sup> *Wireless Microphones R&O*, 30 FCC Rcd at 8744, paras. 10-11.

<sup>55</sup> Microsoft Comments at 7; Cisco/Facebook Comments at 4, 11; Cisco/Facebook/Qualcomm/Intel Reply at 9.

<sup>56</sup> 5 U.S.C. § 553(b); 47 CFR § 74.802(a)(1). In making its request for the Commission to remove the 6875-6900 MHz and 7100-7125 MHz frequency bands from the list of Part 74 LPAS bands, Microsoft references paragraph 51 of the *Notice* where the Commission sought comment on whether there are any Part 74 rules—in addition to those the Commission noted—that need to be removed or modified to reflect the end of the post-Incentive Auction transition period. Microsoft Comments at 7. This paragraph relates only to post-auction transition issues; the Commission was not seeking comment on changes to the Part 74 rules in general.

<sup>57</sup> See 47 CFR § 74.861(d)(1); *Unlicensed Use of the 6 GHz Band*, ET Docket No. 18-295, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852 (2020) (*6 GHz Report and Order*).

<sup>58</sup> Cisco/Facebook/Qualcomm/Intel Reply at 8.

<sup>59</sup> 47 CFR § 15.407(d)(6).

UHF-TV band or make WMAS operations secondary to narrowband wireless microphones.<sup>60</sup> The UHF-TV band has historically been used by wireless microphones for reasons such as good signal propagation and compact device size, and multiple parties support its use by WMAS.<sup>61</sup> Prohibiting WMAS operation in this band would severely reduce the public benefits that more efficient wireless microphone systems will provide.<sup>62</sup> In any event, it is not clear that allowing WMAS in the UHF-TV band would have a significant impact on narrowband wireless microphone use by broadcasters. Because we will not permit licensed WMAS to operate with any greater power than a single licensed narrowband wireless microphone and the wider bandwidth will result in lower PSD, the distance at which a WMAS could interfere with other wireless microphones will be short, meaning that any impact on narrowband wireless microphone usage will be extremely localized. Further, under the Part 74 rules, licensees operating wireless microphones are expected to work with other nearby licensees to avoid mutual interference, and ViacomCBS has provided no evidence that this process would not work between licensees using WMAS and narrowband wireless microphones.<sup>63</sup> We decline to make WMAS secondary to narrowband wireless microphones and therefore give narrowband wireless microphones users greater spectrum rights.<sup>64</sup> Such an action could result in undesirable situations where a single licensed narrowband wireless microphone user could preclude a more efficient WMAS from operating, as opposed to those users being required to work cooperatively to enable both types of wireless microphones to operate.<sup>65</sup>

### 3. Licensed WMAS Technical Requirements

19. In this section, we adopt technical requirements for WMAS devices operating on a licensed basis under Part 74 of the rules. While the current Part 74 rules for wireless microphones are based on narrower bandwidths than those required for WMAS, we permit wider bandwidths for WMAS at no higher power levels than the current rules permit and specify emission masks for these devices.<sup>66</sup>

#### a. Bandwidth

20. *Background.* The Part 74 rules limit wireless microphones operating in the TV bands and 600 MHz duplex gap to a 200 kilohertz maximum bandwidth.<sup>67</sup> Wireless microphones operating in the 941.5-944 MHz, 944-952 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz, 1435-1525 MHz, 6875-6900 MHz and 7100-7125 MHz bands do not have bandwidth limits specified in the Part 74 rules, but are

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<sup>60</sup> Viacom/CBS Reply at 6-7.

<sup>61</sup> Waves Comments at 3 (supporting unlicensed operation in the UHF TV bands); Shure Comments at 6; Sennheiser Comments at 8-10 (supporting unlicensed operation and arguing that wireless microphones need access to low UHF band spectrum). *See also* <https://www.shure.com/en-US/performance-production/louder/why-is-uhf-spectrum-so-important-for-wireless-microphones>.

<sup>62</sup> Sennheiser Comments at 7; Shure Comments at 8; Waves Comments at 3; Lectrosonics Reply at 2.

<sup>63</sup> 47 CFR § 74.803(a). This section requires that “[w]here two or more low power auxiliary licensees need to operate in the same area, the licensees shall endeavor to select frequencies or schedule operation in such manner as to avoid mutual interference.” *Id.*

<sup>64</sup> Viacom/CBS Reply at 6-7.

<sup>65</sup> We note, however, that the situation would be different in a case involving licensed wireless microphones and a Part 15 unlicensed WMAS. Unlicensed devices may not cause harmful interference to licensed services, and in the event an unlicensed device causes harmful interference the operator must cease operation until the condition causing the harmful interference has been corrected. 47 CFR § 15.5.

<sup>66</sup> For example, licensed wireless microphones are currently permitted to operate in the 1435-1525 MHz band at a power level of 250 milliwatts, and WMAS operations in that band would be subject to the same power limit. *See* 47 CFR § 74.861(d)(1).

<sup>67</sup> 47 CFR § 74.861(e)(5).

required to meet the emission masks specified in the 2011 ETSI wireless microphone standard, i.e., ETSI EN 300 422-1 v1.4.2 (2011-08) [“EN 300 422-1 (2011)”], which precludes the use of wide bandwidths, e.g., 1 megahertz or greater.<sup>68</sup> Accordingly, the Commission’s existing rules preclude WMAS operations as proposed by Sennheiser (i.e., use of a 6 megahertz channel). The most recent version of the ETSI standard, established in 2021, permits WMAS to operate using channels up to 20 megahertz.<sup>69</sup>

21. The Commission proposed in the *Notice* to allow WMAS devices to use a 6-megahertz maximum bandwidth, subject to any technical or other limitations inherent to the particular frequency bands within which they would operate.<sup>70</sup> A 6-megahertz channel corresponds to the size of channels in the TV bands where many Part 74 wireless microphones currently operate. The Commission’s proposal would allow WMAS device bandwidth to be smaller than 6 megahertz, either by system design or as needed to comply with the amount of spectrum available under the Commission’s rules.<sup>71</sup> The Commission further proposed that for WMAS devices in the TV bands, the operating channel must fall entirely within a single TV channel (2-36) that is available for Part 74 wireless microphones in accordance with the separation requirements under section 74.802(b).<sup>72</sup> That proposed requirement is intended to prevent a WMAS device from occupying portions of two unused TV channels simultaneously, potentially excluding other uses that require a full 6-megahertz channel, such as unlicensed white space devices or other WMAS devices.<sup>73</sup> The Commission also sought comment on whether it should permit WMAS to operate in wider bandwidths.<sup>74</sup>

22. Parties generally support a 6 megahertz maximum bandwidth limit in the TV bands as well as prohibiting devices from occupying portions of two TV channels simultaneously.<sup>75</sup> NAB believes that WMAS should not be permitted in a bandwidth less than 1 megahertz.<sup>76</sup> Waves believes that bandwidths as low as 1.5 megahertz could be used for WMAS, although Sennheiser argues that WMAS does not work as well with a bandwidth of less than 6 megahertz.<sup>77</sup> Sennheiser, Shure, and Waves support the ETSI-specified 20 megahertz maximum bandwidth outside of the TV bands.<sup>78</sup> NAB believes that a 20 megahertz bandwidth limit may be too restrictive in the 6875-6900 MHz and 7100-7125 MHz bands,

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<sup>68</sup> 47 CFR § 74.861(d)(4). The emission masks in Section 8.3 of ETSI EN 300 422-1 (2011) require certain levels of attenuation at specified frequency offsets from the wireless microphone carrier frequency over a frequency range from one megahertz below to one megahertz above the carrier frequency. [https://www.etsi.org/deliver/etsi\\_en/300400\\_300499/30042201/01.04.02\\_60/en\\_30042201v010402p.pdf](https://www.etsi.org/deliver/etsi_en/300400_300499/30042201/01.04.02_60/en_30042201v010402p.pdf) at 24-27. Section 5.1 of this standard specifies a maximum channel bandwidth of 200 kilohertz at frequencies below 1 GHz, and 600 kilohertz at frequencies above 1 GHz, but the Commission’s rules do not require wireless microphones to comply with this section of the standard. *Id.* at 14.

<sup>69</sup> ETSI EN 300 422-1 (2021) at 17, Section 4.2.3.2.

<sup>70</sup> *Notice*, 36 FCC Rcd at 7917, para. 18.

<sup>71</sup> *Notice*, 36 FCC Rcd at 7917, para. 18. The bandwidth of a WMAS device in the 600 MHz duplex gap (653-657 MHz) would be limited to 4 megahertz, and the amount of spectrum available in each of the 952.850-956.250 MHz and 956.45-959.85 MHz bands is less than 6 megahertz. The 941.5-944 MHz band is only 2.5 megahertz wide, but it could potentially be combined with the adjacent 944-952 MHz band. 47 CFR § 74.802(a)(1)-(2).

<sup>72</sup> *Notice*, 36 FCC Rcd at 7917, para. 18; *see* 47 CFR § 74.802(b).

<sup>73</sup> *Notice*, 36 FCC Rcd at 7917, para. 18.

<sup>74</sup> *Id.* at 7917-18, para. 19.

<sup>75</sup> Microsoft Comments at 8-9; NAB Comments at 7-8; Sennheiser Comments at 7; Lectrosionics Reply at 3-4; Shure Reply at 17; Waves Reply at 5.

<sup>76</sup> NAB Comments at 8.

<sup>77</sup> Waves Feb. 2, 2022 *ex parte* at 8; Sennheiser Comments at 7.

<sup>78</sup> Sennheiser Comments at 7; Shure Comments at 18; Waves Comments at 6.

which have 25 megahertz available for licensed wireless microphones, stating that such a limit would be needlessly inefficient by requiring spectrum to remain unused.<sup>79</sup> Conversely, NCTA is concerned that permitting bandwidths up to 20 megahertz, rather than limiting WMAS to 6 megahertz in these bands, could increase the potential for interference to unlicensed devices.<sup>80</sup>

23. *Discussion.* We will permit licensed WMAS to operate with a maximum bandwidth of 6 megahertz in the VHF-TV and UHF-TV bands specified in Part 74 of the rules. This corresponds to the size of a TV channel and is supported by the record.<sup>81</sup> We also adopt our proposal to require a WMAS device to operate entirely within a single 6 MHz channel and not span parts of two adjacent channels to promote more efficient spectrum sharing between narrowband wireless microphones, WMAS, and white space devices. WMAS devices operating in the 4 megahertz portion of the 600 MHz duplex gap available to licensed wireless microphones will be limited to the width of that band.<sup>82</sup>

24. Outside of the TV bands and 600 MHz duplex gap, we will permit WMAS to operate with bandwidths up to 20 megahertz in spectrum bands where licensed microphone use is permitted by the Part 74 rules and that contain sufficient spectrum, consistent with the 2021 ETSI standard, which requires a WMAS bandwidth that is less than or equal to 20 megahertz.<sup>83</sup> Wireless microphones operating in bands that are less than 20 megahertz wide will be limited to the width of those bands. If ETSI adopts a standard in the future permitting bandwidths greater than 20 megahertz and the Commission, after notice and comment, adopts that standard and makes corresponding amendments to the rules, parties will be permitted to operate WMAS with wider bandwidths in frequency bands that contain sufficient spectrum to do so. We do not believe that a 20 megahertz bandwidth limit is overly restrictive since there is no indication in the record that wireless microphone manufacturers are interested in developing systems with greater bandwidths, and in the event a party has a need to operate in a larger amount of spectrum, it could use multiple WMAS systems. We also do not believe that allowing bandwidths of greater than 6 megahertz outside the TV bands will increase the likelihood of harmful interference to other services or unlicensed operations. On the contrary, as discussed in more detail below, we are requiring WMAS devices operating under Part 74 to comply with the same power limits currently in the rules, resulting in a lower power spectral density and thus reducing the likelihood of harmful interference to other users in the bands where WMAS operates.<sup>84</sup> We decline to require WMAS devices operating in the 6875-6900 MHz and 7100-7125 MHz bands to avoid specific frequencies that could be used for unlicensed operations because under the rules unlicensed devices do not receive interference protection from licensed services.<sup>85</sup> However, we expect that any potential impact to unlicensed operations would be limited as wireless microphones generally only operate over relatively short distances and are generally itinerant and intermittent. Additionally, there are other channels in the 6 GHz band that unlicensed devices could move to at the times that they might be near a wireless microphone operation.

25. We note Sennheiser's argument that WMAS may not work as well using bandwidths less than 6 megahertz and other parties' assertions that WMAS should not be permitted in a bandwidth of less

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<sup>79</sup> NAB Reply at 8.

<sup>80</sup> NCTA Reply at 5.

<sup>81</sup> Microsoft Comments at 8-9; NAB Comments at 7-8; Sennheiser Comments at 7; Lectrosionics Reply at 3-4; Shure Reply at 17; Waves Feb. 17, 2023 *ex parte* at 13.

<sup>82</sup> 47 CFR § 74.802(a)(2).

<sup>83</sup> ETSI EN 300 422-1 (2021), Section 4.2.3.2 at 17.

<sup>84</sup> 47 CFR § 74.861(d)(1), (e)(1). As an example, a WMAS device operating with a 20-megahertz bandwidth will have a power spectral density 13 dB lower than a wireless microphone operating at the same power level with a 1 megahertz bandwidth.

<sup>85</sup> 47 CFR § 15.5(b).

than 1 or 1.5 megahertz.<sup>86</sup> However, we decline to specify a minimum bandwidth for WMAS devices operating in any frequency bands because parties are developing systems that can operate in smaller bandwidths (e.g., 1 or 2 megahertz) and we do not wish to preclude WMAS technical advancements that could allow more efficient operation in smaller bandwidths.<sup>87</sup>

**b. Spectral Efficiency**

26. *Background.* In the *Notice*, the Commission proposed to require WMAS devices to comply with a spectral efficiency requirement of at least three audio channels per megahertz (18 audio channels per 6 megahertz) to ensure that these wider bandwidth devices do not occupy more spectrum than necessary.<sup>88</sup> It stated that this proposal is consistent with ETSI's requirement that WMAS must have at least one mode that supports a minimum of three audio links per megahertz.<sup>89</sup> The Commission believed that a spectral efficiency requirement specified over one megahertz could be more appropriate and more flexible than a requirement specified over the WMAS device maximum channel bandwidth because it provides an easier method to scale total power to different bandwidths, thus allowing manufacturers to produce devices in which the bandwidth could be varied as necessary based on the number of audio channels required and the spectrum available for use in any particular frequency band while also ensuring more efficient use of spectrum for wireless microphone operations.<sup>90</sup> The 2021 ETSI standard does not contain a specific requirement for WMAS to have a mode that supports at least three audio links per megahertz, but the definition of WMAS indicates as an example that it may have the ability to support three or more audio channels per MHz.<sup>91</sup>

27. Parties disagree on the appropriate requirements for spectral efficiency. Sennheiser and Waves support the ETSI requirement that WMAS have an operational mode with at least three audio channels per megahertz, but do not believe that WMAS should be required to operate with at least three audio channels per megahertz at all times.<sup>92</sup> Sennheiser argues that such a requirement could be counterproductive because a single event, such as a concert, may require a large number of wireless microphones for some acts but only a few for others, making it impossible for WMAS to comply with a three audio channel per megahertz requirement at all times, thus necessitating the use of both WMAS and narrowband wireless microphones at the same event.<sup>93</sup> Sennheiser further argues that WMAS inherent design efficiencies, such as ease of configuration and operation, along with the ability to combine vocal and instrument audio channels and in-ear monitors within a single TV channel, will encourage efficient spectrum use without a specific efficiency mandate, and that it anticipates that in the vast majority of cases WMAS will operate with 24 or more audio channels within a 6 megahertz TV channel.<sup>94</sup> However, Microsoft, Lectrosonics, and Shure/NAB/Paramount believe that WMAS should comply with a minimum spectral efficiency standard at all times.<sup>95</sup> Microsoft argues that high performance wireless microphones should be subject to a three audio channels per megahertz minimum spectral efficiency requirement, with

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<sup>86</sup> Sennheiser Comments at 7; NAB Comments at 8; Waves Feb. 2, 2022 *ex parte* at 8.

<sup>87</sup> Shure Jun. 20, 2023 *Ex Parte* at 3.

<sup>88</sup> *Notice*, 36 FCC Red at 7918-19, para. 22.

<sup>89</sup> *Id.* at 7919, para. 22

<sup>90</sup> *Id.*

<sup>91</sup> ETSI EN 300 422-1 (2021), Section 3.1 at 14.

<sup>92</sup> Sennheiser Comments at 3-6; Waves Feb. 17, 2023 *ex parte* at 3.

<sup>93</sup> Sennheiser Comments at 5.

<sup>94</sup> Sennheiser Comments at 4, 6.

<sup>95</sup> Microsoft Comments at 12; Lectrosonics Reply at 3; Shure/NAB/Paramount Nov. 3, 2022 *ex parte* at 2.

lower performance microphones subject to a different requirement to be determined.<sup>96</sup> Lectrosonics believes that the Commission should require a three audio channels per megahertz minimum spectral efficiency, which it states would accommodate the highest fidelity on all channels.<sup>97</sup> Shure/NAB/Paramount argue that WMAS should meet or exceed a 4-audio channel per megahertz spectral efficiency standard.<sup>98</sup>

28. *Discussion.* Consistent with the 2021 ETSI standard and the suggestions of Sennheiser and Waves, we will require WMAS to have an operational mode capable of providing at least three audio channels per megahertz, but we will not require WMAS to operate with a specific minimum number of channels at all times. As Sennheiser notes, WMAS allows dynamic resource allocation within a single TV channel for improved wireless microphone efficiency, e.g., higher audio quality for an act performing on stage, fewer resources (lower audio quality) for an act testing equipment prior to going on stage, and even fewer resources (intercom quality) for an act that has just finished.<sup>99</sup> Because of this ability to modify channel usage, e.g., number of channels and/or their sizes, we agree with Sennheiser that a single spectral efficiency metric that must be met at all times would be inappropriate since the amount of spectrum needed can vary rapidly over time and may not always equal or exceed three audio channels per megahertz. Moreover, requiring a WMAS system to operate with at least three audio channels per megahertz at all times could create other inefficiencies and hardships for users. As noted, microphone usage requirements vary based on specific requirements at the time a microphone is needed. If we were to require by rule that there be at least three audio channels per megahertz in operation at all times, then users would either need to have one or more narrowband microphone systems installed along with a WMAS system for those times when the spectral efficiency requirement was not being met, or the WMAS system would have to establish a connection to microphone(s) not actually needed at a given time just to meet the requirement. Neither outcome is desirable as they lead either to additional cost and complexity for users or inefficient spectrum use without any corresponding benefits to the public. We therefore believe that ETSI's suggestion for WMAS to be capable of operating with three audio channels per megahertz is more appropriate than our initial proposal to require WMAS to meet this efficiency requirement at all times.

29. We recognize the concerns of Microsoft, Lectrosonics, and Shure/NAB/Paramount about the need for efficient spectrum use by WMAS, but note that WMAS is expected to be high-end, and therefore significantly more complex and expensive equipment than current narrowband wireless microphone systems, making it likely to be used only at events where a large number of simultaneous audio channels is necessary.<sup>100</sup> As Sennheiser indicates, WMAS' inherent design efficiencies mean that in the vast majority of cases WMAS will operate with 24 or more audio channels within a 6 megahertz TV channel, thereby using more wireless microphones than required by the minimum capability mode we are requiring.<sup>101</sup> Also, under the Part 74 rules, licensed wireless microphone users are required to coordinate among themselves to ensure that they do not cause mutual interference.<sup>102</sup> This required coordination will help ensure efficient spectrum use by and promote co-existence among parties using both WMAS and conventional narrowband wireless microphones. Finally, we note that any potential

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<sup>96</sup> Microsoft Comments at 12.

<sup>97</sup> Lectrosonics Reply at 3.

<sup>98</sup> Shure/NAB/Paramount Nov. 3, 2022 *ex parte* at 2.

<sup>99</sup> Sennheiser Reply at 3-4.

<sup>100</sup> Microsoft Comments at 12; Lectrosonics Reply at 3; Shure/NAB/Paramount Nov. 3, 2022 *ex parte* at 2.

<sup>101</sup> Sennheiser Comments at 4, 6.

<sup>102</sup> 47 CFR § 74.803(a). This section states that where two or more low power auxiliary licensees need to operate in the same area, the licensees shall endeavor to select frequencies or schedule operation in such manner as to avoid mutual interference. *Id.*

conflicts between WMAS and narrowband wireless microphones are likely to raise similar scenarios as those that occur between parties operating narrowband wireless microphones under the existing rules and for which such users successfully manage and coordinate today, in that a single party could operate multiple narrowband wireless microphones that fill a single 6 megahertz TV or multiple TV channels.

**c. Output Power**

30. *Background.* Under the current Part 74 rules, wireless microphones are limited to 50 milliwatts equivalent isotropically radiated power (EIRP) in the VHF-TV bands, 250 milliwatts conducted power in the UHF-TV band, 20 milliwatts EIRP in the 600 MHz duplex gap, 250 milliwatts conducted power in the 1435-1525 MHz band, and 1 watt conducted power in all other bands.<sup>103</sup> These power limits apply to each individual wireless microphone, so that if, for example, there are 12 wireless microphones operating in close physical proximity within a single 6-megahertz channel, the total power within that channel will be 12 times greater than if there were a single wireless microphone.<sup>104</sup>

31. The Commission proposed to allow WMAS to operate at up to the same maximum power levels as other Part 74 LPAS devices, but sought comment on whether it should allow higher power levels or make other changes to the power limits for WMAS, including how to express the power limits (e.g., PSD or total power, conducted or radiated), and whether it should be capped or permitted to scale with the number of audio channels.<sup>105</sup> The Commission also sought comment on whether there is a need to modify the rules to resolve an inconsistency in the power limits for Part 74 wireless microphones that operate in the TV bands (EIRP in the VHF bands and conducted power in the UHF band).<sup>106</sup> Commenters generally support allowing licensed WMAS to operate at up to the maximum power levels currently permitted in the rules, e.g., up to 50 milliwatts for operation in the VHF-TV bands and up to 250 milliwatts in the UHF-TV band, although as noted above several parties oppose any WMAS operation in the 6875-6900 MHz and 7100-7125 MHz bands.<sup>107</sup> Microsoft supports modifying the Part 74 rules to remove an inconsistency in the power specification between the VHF-TV and UHF-TV bands, while Shure and Lectrosionics do not believe that we need to resolve this inconsistency.<sup>108</sup>

32. *Discussion.* We will permit WMAS to operate on a licensed basis under the Part 74 rules at the same power levels currently permitted under these rules, i.e., 50 milliwatts EIRP in the VHF-TV bands, 250 milliwatts conducted power in the UHF band, 20 milliwatts EIRP in the 600 MHz duplex gap, 250 milliwatts conducted power in the 1435-1525 MHz band, and 1 watt conducted power in all other

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<sup>103</sup> 47 CFR § 74.861(d)(1), (e)(1).

<sup>104</sup> As a practical matter, wireless microphones generally operate at less than the maximum power the rules allow due to a number of considerations, such as the need to extend battery life, reduced interference between wireless microphones, and because the maximum power is simply not necessary in many applications.

<sup>105</sup> *Notice*, 36 FCC Red at 7920, para. 27.

<sup>106</sup> *Notice*, 36 FCC Red at 7921, para. 29. 47 CFR § 74.861(e)(1) specifies the power limit for wireless microphones in the UHF-TV band in terms of conducted power, while the power limits for wireless microphones in the VHF-TV bands and the 600 MHz duplex gap are expressed in terms of EIRP.

<sup>107</sup> Sennheiser Comments at 8; Microsoft Comments at 12; NAB Comments at 8; Waves Audio Comment at 16 (each support limiting WMAS to the same maximum power currently permitted in the Part 74 rules). Shure initially suggested higher power levels for licensed WMAS than the rules currently permit for licensed narrowband wireless microphones, but in subsequent filings recommends up to 250 milliwatts for licensed WMAS, which is the same power level currently permitted for licensed wireless microphones in the UHF-TV bands. Shure Comments at 19; Shure/NAB/Paramount Nov. 3, 2022 *Ex Parte* at 2. Other parties request that the Commission not permit WMAS in the 6875-6900 MHz and 7100-7125 MHz bands. Cisco/Facebook Comments at 14-16; Wi-Fi Alliance Comments at 1; Cisco/Facebook/Qualcomm/Intel Reply at 9; NCTA Reply at 1-2.

<sup>108</sup> Microsoft Comments at 13; Shure Comments at 23; Lectrosionics Reply at 4.



bands.<sup>109</sup> These power levels are supported by the record.<sup>110</sup> Because we are permitting WMAS to operate with wider bandwidths than the Part 74 rules currently permit, the power spectral density for WMAS, which will operate using wider bandwidths than that used for narrowband wireless microphones, will be lower than for a single narrowband wireless microphone, and therefore significantly lower than when multiple narrowband wireless microphones operate within a single channel. This will result in a decreased potential for WMAS to cause harmful interference to other users in the bands where they operate, including broadcast TV, licensed and unlicensed wireless microphones (narrowband or WMAS), unlicensed white space devices, and aeronautical mobile telemetry (AMT) operations in the 1435-1525 MHz band.

33. We decline to modify the rules to remove the inconsistency in the power specification for licensed wireless microphones in the TV bands (EIRP in the VHF-TV-bands and conducted power in the UHF-TV band).<sup>111</sup> Wireless microphone manufacturers argue that there is no need for changes, and Microsoft does not indicate any specific harms from maintaining the current rules.<sup>112</sup> Because no party has shown a need to modify the rules, we retain the current power specifications for Part 74 wireless microphones in the TV bands without change.

#### **d. Emission Mask and Spurious Emission Limits**

34. *Background.* The Commission proposed to require WMAS devices to comply with the transmit emission mask in the 2017 version of ETSI standard EN 300 422-1 (2017).<sup>113</sup> It stated that this proposal is consistent with the current Part 74 wireless microphone rules that require narrowband wireless microphones to comply with ETSI transmit emission masks (2011 version).<sup>114</sup> The Commission also proposed to require that WMAS emissions outside the band where the emission mask is defined comply with the spurious emission limits in Section 8.4 of ETSI EN 300 422-1 (2017).<sup>115</sup> It requested comment on whether it should adopt a later version instead of the 2017 version if ETSI updates its applicable standards for WMAS during the pendency of this rulemaking.<sup>116</sup> The Commission also sought comment on whether there is a need to adopt the ETSI intermodulation distortion limits, as suggested by Shure.<sup>117</sup>

35. ETSI released a revised version of EN 300 422-1 in November 2021 subsequent to the adoption of the *Notice*.<sup>118</sup> The emission mask for WMAS in the 2021 version is the same as the mask in the 2017 version, except that the last step of the revised mask (60 dB below the carrier) is specified only up to a frequency offset 2.5 times the WMAS bandwidth above and below the carrier rather than 5 times

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<sup>109</sup> 47 CFR § 74.861(d)(1), (e)(1).

<sup>110</sup> Sennheiser Comments at 8; Microsoft Comments at 12; NAB Comments at 8; Waves Audio Comment at 16; Shure/NAB/Paramount Nov. 3, 2022 *ex parte* at 2.

<sup>111</sup> 47 CFR § 74.861(e)(1)(i), (ii).

<sup>112</sup> Microsoft Comments at 13; Shure Comments at 23; Lectrosionics Reply at 4.

<sup>113</sup> *Notice*, 36 FCC Rcd at 7922, para. 31.

<sup>114</sup> *Id.* (citing 47 CFR § 74.861(d)(4), (e)(7)).

<sup>115</sup> *Id.*

<sup>116</sup> *Id.*

<sup>117</sup> *Notice*, 36 FCC Rcd at 7922, para. 33.

<sup>118</sup> European Telecommunications Standards Institute ETSI EN 300 422-1 v2.2.1 (2021-11), [https://www.etsi.org/deliver/etsi\\_en/300400\\_300499/30042201/02.02.01\\_60/en\\_30042201v020201p.pdf](https://www.etsi.org/deliver/etsi_en/300400_300499/30042201/02.02.01_60/en_30042201v020201p.pdf), Section 4.2.4.2.2, at 19-20 [ETSI EN 300 422-1 (2021)].

the WMAS bandwidth as in the 2017 version.<sup>119</sup> In either case, emissions that fall beyond the limits of the transmit emission mask must comply with spurious emission limits.<sup>120</sup>

36. Wireless microphone manufacturers support adoption of the ETSI transmit mask and spurious emission limits for WMAS. Sennheiser, Waves, and Shure specifically support use of the 2021 version of the ETSI standard, although Waves believes that there are errors in the ETSI measurement procedures for determining whether a device complies with the emission mask.<sup>121</sup> Waves requests that the Commission permit alternative measurement procedures for determining compliance.<sup>122</sup> Microsoft states that it has no objection to incorporating the 2017 ETSI standard, but states that the Commission should not incorporate any ETSI standards that are finalized during the pendency of this proceeding without providing another public comment period but does not indicate what types of changes in later-adopted standards might be problematic.<sup>123</sup> Sennheiser and Shure support a requirement for wireless microphones to comply with the ETSI intermodulation distortion limits.<sup>124</sup> While these parties commented with respect to the 2017 version of the ETSI standard, they also indicated that they would support rules incorporating portions of the 2021 ETSI standard that was at that time under development.<sup>125</sup> The 2021 version of the standard changed the terminology for the recommended requirement from “intermodulation distortion” to “transmitter intermodulation attenuation” but retained the same technical limit.<sup>126</sup>

37. *Discussion.* We require WMAS operating under Part 74 to comply with the emission mask and spurious emission limits in ETSI EN 300 422-1 (2021).<sup>127</sup> Specifically, emissions within the band from  $2.5 \times B$  below to  $2.5 \times B$  above the carrier frequency, where  $B$  is the channel bandwidth, shall comply with the emission mask in Figure 3 of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11); and emissions outside of this mask shall comply with the spurious emission limits specified in section 4.2.4.1.2 of ETSI EN 300 422-1 V2.2.1 (2021-11).<sup>128</sup> This mask and these emission limits will protect licensed operations in adjacent bands from WMAS operations, including broadcast TV and licensed wireless microphones, and will enable coexistence with unlicensed operations, including white space devices and unlicensed wireless microphones. Wireless microphone manufacturers support these

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<sup>119</sup> Compare ETSI EN 300 422-1 (2017), Section 8.3.4.3 at 32, with ETSI EN 300 422-1 (2021), Section 4.2.4.2.2 at 20.

<sup>120</sup> ETSI EN 300 422-1 (2017), Section 8.4.3 at 37; ETSI EN 300 422-1 (2021), Section 4.2.4.1.2 at 18.

<sup>121</sup> Sennheiser Dec. 12, 2022 *ex parte* at 16; Waves Dec. 19, 2022 *ex parte* at 3-4; Shure Nov. 29, 2022 *ex parte* at 10.

<sup>122</sup> Waves Dec. 19, 2022 *ex parte* at 5-8.

<sup>123</sup> Microsoft Comments at 13-14.

<sup>124</sup> Sennheiser Comments at 7; Shure Comments at 24-25; ETSI EN 300 422-1 (2021), Section 4.2.5 at 21. The 2021 ETSI standard uses the term “transmitter intermodulation attenuation” which it defines as “a measure of the capability of a transmitter to inhibit the generation of signals in its non-linear elements caused by the presence of the transmitter power and an interfering signal entering the transmitter via its antenna.” ETSI EN 300 422-1 (2021), Section 4.2.5 at 21.

<sup>125</sup> *Id.*

<sup>126</sup> Compare ETSI EN 300 422-1 (2017) Section 8.5 at 38-39, with ETSI EN 300 422-1 (2021), Section 4.2.5 at 21. In both cases the maximum intermodulation distortion product must be at least 40 dB below the output power of the device under test.

<sup>127</sup> ETSI EN 300 422-1 (2021), Section 4.2.4.2.2 at 20; ETSI EN 300 422-1 (2021), Section 4.2.4.1.2 at 18.

<sup>128</sup> *Id.*

requirements.<sup>129</sup> While Microsoft expresses concern about adopting ETSI standards finalized after the 2017 standard, we observe that there are no significant differences in the WMAS emission mask and the spurious emission limits between the 2017 standard and the 2021 standard. Specifically, both the 2017 and 2021 masks are identical up to a frequency offset 2.5 times the WMAS bandwidth above and below the carrier, which for WMAS on a 6-megahertz TV channel covers the operating channel as well as the upper and lower first and second adjacent TV channels. The only difference between the masks is the point at which a WMAS must comply with the ETSI spurious emission limits (more than 2.5 times the WMAS bandwidth removed from the carrier in the 2021 standard, as opposed to 5 times the WMAS bandwidth from the carrier in the 2017 standard). Microsoft raises no objection to the use of the mask in the ETSI 2021 standard in response to wireless microphone manufacturers' filings in support of this standard.<sup>130</sup>

38. The spurious emission limits are specified differently in the 2021 ETSI standard than in the 2017 standard (in dBm rather than microwatts or nanowatts), but the limits themselves are equivalent.<sup>131</sup> Because the ETSI spurious emission limit in the TV bands is generally more stringent than the limit at the edge of the WMAS emission mask, and because the 2021 mask covers a narrower frequency range, the emission mask in the 2021 ETSI standard will provide slightly greater protection to operations in adjacent bands than the 2017 ETSI mask since the lower spurious emission limits apply at a lesser frequency separation from the carrier.<sup>132</sup> In addition, the ETSI spurious emission limit generally provides greater protection than the Part 15 out-of-band emission limits.<sup>133</sup> Thus, incorporating the 2021 ETSI WMAS emission mask and spurious emission limits instead of those in the 2017 standard will not result in any increased likelihood of harmful interference to operations in adjacent bands, including other wireless microphones and unlicensed white space devices.

39. We decline to require wireless microphones, either narrowband or WMAS, to comply with the ETSI intermodulation distortion limits, as suggested by Shure and Sennheiser.<sup>134</sup> The Commission's rules do not currently specify any comparable type of limits for wireless microphones, so requiring wireless microphones to comply with these limits would be a new requirement. The record does not indicate specific benefits associated with adopting this requirement, and there is no information

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<sup>129</sup> Sennheiser Dec. 12, 2022 *ex parte* at 16; Waves Dec. 19, 2022 *ex parte* at 3-4; Shure Nov. 29, 2022 *ex parte* at 10.

<sup>130</sup> Sennheiser Dec. 12, 2022 *ex parte* at 16; Waves Dec. 19, 2022 *ex parte* at 3-4; Shure Nov. 29, 2022 *ex parte* at 10.

<sup>131</sup> ETSI EN 300 422-1 (2017), Section 8.4.3 at 37; ETSI EN 300 422-1 (2021), Section 4.2.4.1.2 at 18. The 2021 ETSI standard specifies three spurious emission limits: -36 dBm at frequencies up to 1 GHz, with a tighter limit of -54 dBm at certain frequencies below 1 GHz that include broadcast television, and -30 dBm at frequencies above 1 GHz. ETSI EN 300 422-1 (2021), Section 4.2.4.1.2 at 18. These limits are expressed in terms of effective radiated power (ERP). *See id.* The 2017 standard specifies ERP limits for these bands of 250 nanowatts, 4 nanowatts and 1 microwatt respectively, ETSI EN 300 422-1 (2017), Section 8.4.3 at 37, which are equivalent to the limits in the 2021 standard. The 2021 ETSI standard also eliminated the specification of lower spurious limits when a device is in a standby mode and slightly reduced the size of one of the bands subject to the tighter -54 dBm spurious limit.

<sup>132</sup> The 2021 ETSI WMAS emission mask requires an attenuation of 60 dB at the edge of the mask. ETSI EN 300 422-1 (2021), Section 4.2.4.2.2, Figure 3 at 20. If, for example, a wireless microphone operates at 50 milliwatts (17 dBm) EIRP, it has an ERP of 14.8 dBm and would have to be attenuated to -45.2 dBm ERP at the edge of the mask. The 2021 ETSI spurious emission limit in the TV bands is -54 dBm ERP, which is almost 9 dB more stringent than the mask requires. ETSI EN 300 422-1 (2021), Section 4.2.4.1.2 at 18.

<sup>133</sup> 47 CFR § 15.209(a). The out-of-band limit in the UHF-TV band (470-608 MHz) is 200 microvolts per meter at a distance of 3 meters. *Id.* This corresponds to an -51.3 dBm ERP, which is greater than the -54 dBm ERP ETSI spurious emission limit in that band. *See* ETSI EN 300 422-1 (2021), Section 4.2.4.1.2 at 18.

<sup>134</sup> Sennheiser Comments at 7; Shure Comments at 22; ETSI EN 300 422-1 (2021), Section 4.2.5 at 21.

on potential costs or other burdens, such as increased complexity for certification testing or the need for manufacturers to redesign equipment to comply with a new requirement.

40. We note Wave's assertion that the 2021 ETSI standard contains errors in the measurement procedure for determining compliance with the emission mask.<sup>135</sup> To the extent that Waves believes that there are errors, it should work with ETSI to address its concerns. However, in response to Wave's request that the Commission permit alternative measurement procedures for determining compliance,<sup>136</sup> we note that the Commission's rules already provide flexibility in the measurement procedures that parties may use in preparing data for an application for certification.<sup>137</sup> Specifically, test data must be measured in accordance with 1) bulletins or reports prepared by the Commission's Office of Engineering and Technology (OET); 2) those procedures acceptable to the Commission and published by national engineering societies; or 3) any other measurement procedure acceptable to the Commission.<sup>138</sup> Thus, the rules have provisions that could allow Waves to use a procedure that is a variation of, or an alternative to, the 2021 ETSI measurement procedure for determining compliance with the emission mask. If Waves wishes to do so, it should contact OET prior to applying for certification to determine whether its proposed alternative measurement procedures are acceptable to the Commission.<sup>139</sup>

#### **B. Updating Technical Rules for Existing Part 74 LPAS Wireless Microphones to Revised ETSI Standards**

41. *Background.* The existing Part 74 LPAS wireless microphone technical rules incorporate certain ETSI standards that date to 2011.<sup>140</sup> In the *Notice*, the Commission proposed to update the existing Part 74 LPAS device rules to require the use of an updated ETSI standard that applies to those type of devices (i.e., non-WMAS wireless microphones).<sup>141</sup> Specifically, it proposed to update the existing Part 74 wireless microphone rules to specify the transmit emission masks and spurious emission limits in EN 300 422-1 (2017) in place of the emission masks in the 2011 version of this standard which are currently specified in the rules.<sup>142</sup> The Commission also proposed to slightly reorganize the rule sections specifying the emission masks and spurious emission limits to make them easier to follow.<sup>143</sup> In making its proposals, the Commission noted that there is one significant difference regarding the emission masks between the 2011 and 2017 versions of the ETSI digital wireless microphone standard.<sup>144</sup> The 2011 standard defines the emission masks for digital systems over a frequency range from one megahertz below to one megahertz above the wireless microphone carrier frequency, whereas the newer 2017 standard defines the emission masks over a frequency range from 5 x B below to 5 x B above the carrier

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<sup>135</sup> Waves Dec. 19, 2022 *ex parte* at 3-4. No other party raised similar concerns.

<sup>136</sup> Waves Dec. 19, 2022 *ex parte* at 5-8.

<sup>137</sup> *See generally* 47 CFR § 2.947.

<sup>138</sup> 47 CFR § 2.947(a).

<sup>139</sup> 47 CFR § 2.947(a)(3).

<sup>140</sup> *Notice*, 36 FCC Rcd at 7923, para. 35. These ETSI standards apply to each of the bands in which the Commission proposed to authorize WMAS – specifically, the VHF-TV bands (54-72 MHz, 76-88 MHz and 174-216 MHz), the UHF-TV band (470-608 MHz), the 653-657 MHz segment of the 600 MHz duplex gap, and the 941.5-944 MHz, 944-952 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz, 1435-1525 MHz, 6875-6900 MHz and 7100-7125 MHz bands. 47 CFR §§ 74.861(d)(4), (e)(7), 15.236(g).

<sup>141</sup> *Notice*, 36 FCC Rcd at 7923, para. 36.

<sup>142</sup> *Notice*, 36 FCC Rcd at 7923, para. 36 (citing 47 CFR § 74.861(d)(4), (e)(7)).

<sup>143</sup> *Notice*, 36 FCC Rcd at 7923, para. 36.

<sup>144</sup> *Notice*, 36 FCC Rcd at 7923, para. 37.

frequency, where B is the channel bandwidth.<sup>145</sup> This difference means that digital wireless microphones that comply with the 2017 emission masks could potentially operate with a wider bandwidth than those that comply with the older mask defined in the 2011 standard.<sup>146</sup> The Commission sought comment on any updates to the ETSI standard that are currently in progress, when a new version is expected to be available, and how it differs from the 2017 standard.<sup>147</sup> The Commission sought comment on whether a transition period would be necessary for wireless microphone manufacturers to comply with an updated ETSI standard, and if so, how long a transition period would be required.<sup>148</sup>

42. The 2021 ETSI standard released subsequent to the *Notice* slightly modified the emission masks for narrowband (non-WMAS) analog and digital wireless microphones from the masks specified in the 2017 version of the ETSI standard.<sup>149</sup> Specifically, it changed the frequency range over which these masks are defined to  $2.5 \times B$  above and below the wireless microphone carrier frequency, where B is the channel bandwidth.<sup>150</sup> The 2021 standard specifies a single mask for digital wireless microphones rather than separate masks for frequencies above and below 2 gigahertz, and no longer requires any roll-off within the operating channel of analog wireless microphones, but it still requires the same amount of roll-off (60 dB) at the edge of the operating channel.<sup>151</sup> In addition, the revised masks for both analog and digital wireless microphones require 80 dB of attenuation at the edge of the masks.<sup>152</sup> Sennheiser and Shure support adopting the 2021 ETSI mask and spurious emission limits.<sup>153</sup> Microsoft states that it has no objection to incorporating the 2017 ETSI standard, but states that the Commission should not incorporate any ETSI standards that are finalized during the pendency of this proceeding without providing for another period of public comment.<sup>154</sup> No party suggested that there is a need for a transition period if the Commission adopts the updated ETSI emission masks or spurious emission limits.

43. *Discussion.* We will require analog and digital narrowband (i.e., non-WMAS) wireless microphones operating under Part 74 to comply with the emission masks and spurious emission limits in ETSI EN 300 422-1 (2021).<sup>155</sup> Specifically, emissions within the band from  $2.5 \times B$  below to  $2.5 \times B$  above the carrier frequency, where B is the channel bandwidth, shall comply with either the emission mask in Figure 1 (analog) or Figure 2 (digital) of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11); and emissions outside of this mask shall comply with the spurious emission limits specified in section 4.2.4.1.2 of ETSI EN 300 422-1 V2.2.1 (2021-11).<sup>156</sup> These masks and emission limits will protect licensed operations in adjacent bands, including broadcast TV and licensed wireless microphones,

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<sup>145</sup> *Notice*, 36 FCC Rcd at 7923, para. 37 (citing ETSI EN 300 422-1 (2011) at 26-27, Section 8.3.2.2; ETSI EN 300 422-1 (2017) at 30, Section 8.3.3.2).

<sup>146</sup> *Notice*, 36 FCC Rcd at 7923, para. 37.

<sup>147</sup> *Notice*, 36 FCC Rcd at 7924, para. 38.

<sup>148</sup> *See Notice*, 36 FCC Rcd at 7924, para. 38.

<sup>149</sup> ETSI EN 300 422-1 (2021).

<sup>150</sup> EN 300 422-1 (2021) at 19-20, Section 4.2.4.2.2.

<sup>151</sup> *Id.*

<sup>152</sup> *Id.* The 2017 masks require 90 dB attenuation at the edge for analog wireless microphones and for digital wireless microphones operating below 2 GHz. ETSI EN 300 422-1 (2017) Sections 8.3.2.2, 8.3.3.2 at 28, 30. The 2017 mask for digital wireless microphones operating above 2 GHz requires 60 dB attenuation at the edge. ETSI EN 300 422-1 (2017) Section 8.3.3.2 at 30.

<sup>153</sup> Sennheiser Comments at 7; Shure Dec. 6, 2023 *ex parte* at 2.

<sup>154</sup> Microsoft Comments at 14.

<sup>155</sup> ETSI EN 300 422-1 (2021), Section 4.2.4.2.2 at 19-20; ETSI EN 300 422-1 (2021), Section 4.2.4.1.2 at 18.

<sup>156</sup> *Id.*

and will enable coexistence with unlicensed operations, including white space devices and unlicensed wireless microphones. In addition, incorporating the latest ETSI emission masks and spurious emission limits into the rules will harmonize certain Commission wireless microphone requirements with those used in other parts of the world, which will reduce the number of different regulatory requirements with which manufacturers must comply reducing development and manufacturing costs as well as costs to consumers. While Microsoft expresses concern about adopting ETSI standards finalized after the 2017 standard, we observe that the differences between the narrowband emission masks in the 2017 standard and in the 2021 standard are not significant and would not increase the potential for harmful interference to operations in adjacent bands, such as unlicensed white space devices.<sup>157</sup> We therefore adopt the 2021 ETSI standard for narrowband emission masks. As discussed above, the 2021 ETSI standard for spurious emission limits is equivalent to the 2017 standard, so we require narrowband wireless microphones to comply with the spurious emission limits in the 2021 ETSI standard. Because there are no significant differences between the 2021 ETSI standard and the 2011 ETSI standard currently referenced in the rules, and because no party indicated that there is a need for a significant transition period to comply with the 2021 ETSI standard, we will make the rule changes referencing the 2021 standard effective 30 days after publication in the Federal Register. Parties that are not already using the 2021 ETSI standard are encouraged to begin using it as soon as possible.<sup>158</sup>

**C. Revisions to the Technical Rules for Part 15 Unlicensed Wireless Microphone Operations in the TV Bands, the 600 MHz Guard Band, and the 600 MHz Duplex Gap**

44. *Background.* The Commission generally applies the same technical rules to unlicensed and licensed wireless microphones operations in the TV bands and the 600 MHz duplex gap, with certain differences relating to operation.<sup>159</sup> In the TV bands, the technical requirements applicable to unlicensed wireless microphones are the same as those under Part 74,<sup>160</sup> while the maximum permissible power for unlicensed wireless microphones in the UHF-TV band is lower (50 milliwatts) than permitted for licensed LPAS wireless microphone operations (250 milliwatts) in that band.<sup>161</sup> The rules for operation in the 600 MHz duplex gap (652-663 MHz) differ between unlicensed wireless microphone and licensed Part 74 wireless microphone operations in that licensed wireless microphones may operate in a 4-megahertz

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<sup>157</sup> In the case of the analog mask, the amount of attenuation at the edge of the wireless microphone operating channel is the same in both cases (60 dB), as is the attenuation at the next step of the mask (80 dB). ETSI EN 300 422-1 (2017) Sections 8.3.2.2 at 28; ETSI EN 300 422-1 (2021), Section 4.2.4.2.2 at 19. The main difference is the frequency at which the mask ends and the spurious emissions apply. In the case of the digital wireless microphone mask, the 2021 ETSI standard slightly modified the 2017 mask for digital wireless microphones operating below 2 GHz and made it applicable to all digital wireless microphones, including those operating above 2 GHz. ETSI EN 300 422-1 (2017) Sections 8.3.3.2 at 30; ETSI EN 300 422-1 (2021), Section 4.2.4.2.2 at 20. The modifications to this mask in the 2021 ETSI standard are not significant, in that the attenuation required at the edge of the wireless microphone operating channel is the same in both cases (30 dB), as is the next step of the mask (80 dB). *Id.* As with the analog emission mask, the main difference between the 2017 and 2021 standards is the frequency at which the mask ends and the spurious emissions apply.

<sup>158</sup> In the event a party needs additional time to comply with the revised standard, e.g., equipment has been tested to show compliance with the 2011 standard but an application for certification has not been filed before the effective date of the new rules, OET will, on a limited basis, permit the use of data showing compliance with the 2011 standard. *See* 47 CFR § 2.947(a) (addressing the use of measurement procedures acceptable to the Commission).

<sup>159</sup> *Notice*, 36 FCC Rcd at 7925, para. 40.

<sup>160</sup> Licensed and unlicensed wireless microphones must comply with the same bandwidth, channelization, frequency stability, emission mask, and spurious emission limits. 47 CFR §§ 74.802(c), 74.861(e)(4)-(5), (7), 15.236(f)-(g).

<sup>161</sup> 47 CFR § 15.236(d)(1) (limiting power in the VHF-TV and UHF-TV bands to 50 milliwatts EIRP); 47 CFR § 74.861(e)(1) (limiting power in the VHF-TV bands to 50 milliwatts EIRP and in the UHF-TV band to 250 milliwatts conducted).

portion (653-657 MHz), while unlicensed wireless microphones may operate in a separate 6-megahertz portion (657-663 MHz), both limited to 20 milliwatts EIRP.<sup>162</sup> Unlicensed wireless microphones share this 6-megahertz portion of the 600 MHz duplex gap with unlicensed white space devices, which operate under other Part 15 rules.<sup>163</sup> The emission mask and the spurious emission limits that apply to unlicensed wireless microphones in the TV bands and the 600 MHz guard band and duplex gap are the same as those that apply to licensed wireless microphones.<sup>164</sup>

45. Consistent with its proposals to update the emission masks and spurious emission limits in the existing Part 74 LPAS rules for licensed wireless microphones, the Commission proposed to update the Part 15 rules to specify the transmit emission masks and the spurious emission limits in EN 300 422-1 (2017) in place of the emission masks and spurious emission limits in the 2011 version of this standard which are currently specified in the rules.<sup>165</sup> The Commission also sought comment on any updates to the ETSI standard that are currently in progress, when a new version is expected to be available, and how it differs from the 2017 standard.<sup>166</sup> As noted above, ETSI issued a revised standard in 2021 that made additional changes to the emissions masks for analog and non-WMAS digital wireless microphones.

46. The Commission recognized that there are unlicensed entities that operate wireless microphones in UHF bands that have a need to operate a large number of wireless microphones, but do not fall into any of the categories that permit license eligibility under Part 74, and thus must operate wireless microphones on an unlicensed basis in the TV bands, the 600 MHz guard band, and the 657-663 MHz portion of the 600 MHz duplex gap.<sup>167</sup> The Commission sought comment on whether WMAS operations should be permitted on an unlicensed basis in any of those bands, and if so, on the technical rules and any restrictions that should apply.<sup>168</sup> Specifically, it sought comment on the appropriate power limits and whether the same bandwidth, spectral efficiency requirements, emission mask, and spurious limits that apply to licensed WMAS should also apply to unlicensed WMAS.<sup>169</sup>

### 1. Unlicensed WMAS operation under Part 15

47. The record is mixed on whether the Commission should permit WMAS to operate on an unlicensed basis under Part 15. Sennheiser, Shure, and Waves support allowing WMAS on an unlicensed basis.<sup>170</sup> Sennheiser argues that unlicensed operation will benefit all spectrum users, including white space device users, because WMAS reduces the number of TV channels that would need to be occupied by wireless microphones, particularly as compared to conventional narrowband wireless microphones.<sup>171</sup> Shure argues that the number of unlicensed wireless microphone users far exceeds the number of licensed users in the United States, so the full benefit of WMAS technology can only be realized if WMAS is

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<sup>162</sup> Compare 47 CFR § 74.861(e)(1)(iii), with *id.* § 15.236(d)(2).

<sup>163</sup> 47 CFR §§ 15.236(c)(3), 15.707(a)(2).

<sup>164</sup> Compare 47 CFR § 74.861(e)(7), with *id.* § 15.236(g).

<sup>165</sup> Notice, 36 FCC Rcd at 7925, para. 42 (citing 47 CFR § 15.236(g)).

<sup>166</sup> Notice, 36 FCC Rcd at 7926, para. 43.

<sup>167</sup> Notice, 36 FCC Rcd at 7926, para. 44. Eligible entities include broadcast station licensees, broadcast network entities, cable television system operators, motion picture producers, television program producers, licensees and certain operators in the Broadband Radio Service, large venue owners or operators that routinely use 50 or more wireless microphones, and professional sound companies. 47 CFR §§ 74.801, 74.832.

<sup>168</sup> Notice, 36 FCC Rcd at 7926, para. 45.

<sup>169</sup> *Id.*

<sup>170</sup> Sennheiser Comments at 8; Shure Comments at 3; Waves Comments at 18.

<sup>171</sup> Sennheiser Comments at 8.

available to unlicensed as well as to licensed users.<sup>172</sup> It notes that many professional audio users routinely require multiple interference-free channels but are not able to obtain a license because they cannot meet the 50 microphone threshold.<sup>173</sup>

48. Lectrosionics argues that the Commission should not allow WMAS to operate under Part 15 because of the interference risk to licensed wireless microphone operations, which have priority, and the potential difficulty in identifying unlicensed WMAS operators to coordinate frequency usage and resolve problems.<sup>174</sup> ViacomCBS argues that the Commission should limit WMAS eligibility to licensed operations to help ensure that this technology is deployed where it will increase efficiency and not in situations where it may have the opposite effect.<sup>175</sup> NCTA requests that if the Commission permits WMAS in the 6 GHz bands, it should limit eligibility to Part 74 licensees to promote coexistence with other users of these bands.<sup>176</sup>

49. Microsoft opposes allowing unlicensed WMAS in the TV bands, expressing concern about potential interference to white space devices, particularly personal/portable devices used indoors.<sup>177</sup> Microsoft also expresses concern about whether there will be an expectation that a venue or sound company using a Part 15 WMAS system will be entitled to receive protection from white space devices.<sup>178</sup> It notes that the Commission sought comment in 2017 on whether to expand eligibility for Part 74 licensing, which could make some parties that currently operate unlicensed wireless microphones eligible for protection in the white space database, and states that the Commission should consider this proceeding in tandem with the 2017 wireless microphones proceeding.<sup>179</sup> NAB initially opposed permitting WMAS operation in the TV bands on an unlicensed basis, but in a joint filing with Shure and Paramount and a subsequent filing with Paramount supported unlicensed operation in the TV bands subject to certain power, bandwidth, and spectral efficiency requirements.<sup>180</sup> These parties suggest permitting unlicensed operation in the TV bands at 50 milliwatts in a 1 megahertz bandwidth with a minimum of 4 audio channels, or 100 milliwatts in a 2 megahertz bandwidth with a minimum of 8 audio channels.<sup>181</sup>

**a. Frequency bands**

50. We will permit WMAS to operate on an unlicensed basis under Part 15 in the VHF-TV and UHF-TV bands and in the upper 6-megahertz segment of the 600 MHz duplex gap (657-663 MHz), under the same definition of WMAS that we adopt for licensed WMAS. As Shure notes, there are many professional applications for wireless microphones where the operator is not eligible for a Part 74 license because it does not use 50 or more wireless microphones.<sup>182</sup> Thus, the benefits of WMAS cannot be fully

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<sup>172</sup> Shure Comments at 5.

<sup>173</sup> Shure Comments at 4.

<sup>174</sup> Lectrosionics Reply at 3.

<sup>175</sup> ViacomCBS Reply at 7.

<sup>176</sup> NCTA Reply at 6-7.

<sup>177</sup> Microsoft Comments at 15. Microsoft argues that the risk of harmful interference from unlicensed wireless microphones to unlicensed fixed, mobile, and narrowband white space devices is considerably less because those categories of white space device operate almost exclusively outdoors. *Id.*

<sup>178</sup> Microsoft Comments at 15.

<sup>179</sup> Microsoft Reply at 9.

<sup>180</sup> NAB Comments at 6; Shure/NAB/Paramount Nov. 3, 2022 *ex parte* at 2; NAB/Paramount June 2, 2023 *ex parte* at 3.

<sup>181</sup> Shure/NAB/Paramount Nov. 3, 2022 *ex parte* at 2; NAB/Paramount June 2, 2023 *ex parte* at 3.

<sup>182</sup> Shure Comments at 4.



realized unless we allow WMAS to operate on an unlicensed basis in addition to a licensed basis.<sup>183</sup> We agree with Sennheiser that WMAS allows for more efficient use, i.e., fewer TV channels are required for large events that use a large number of wireless microphones, thus making more spectrum available for other applications, such as narrowband (non-WMAS) wireless microphones and white space devices.<sup>184</sup> We are not permitting unlicensed WMAS to operate in the 600 MHz guard band (614-616 MHz) since no party indicated that there is a need to do so.

51. We disagree with Lectrosonics and ViacomCBS that we should limit WMAS to licensed Part 74 operations only.<sup>185</sup> Similar to licensed WMAS operations, unlicensed WMAS operations are unlikely to cause harmful interference to licensed wireless microphones since the wider bandwidth will result in a low PSD, limiting the range at which interference could occur. WMAS operating under Part 15 must not cause harmful interference to licensed operations, including licensed wireless microphones, so in the event a Part 15 WMAS system causes harmful interference to a licensed wireless microphone, the Part 15 system would have to move to a different frequency or cease operation.<sup>186</sup> It should not be difficult for a licensed wireless microphone user to locate an unlicensed WMAS system that causes interference since the range at which a system could cause interference to licensed wireless microphones will be short, and a WMAS system a short distance away should be easily identifiable by a large number of wireless microphones communicating with a sophisticated centralized base station. With regard to ViacomCBS' concern about efficient spectrum use, unlicensed WMAS will be subject to the same spectral efficiency requirements as licensed WMAS, and there is no evidence in the record that unlicensed WMAS operations will be less efficient than licensed. Furthermore, in response to NCTA's request that we limit eligibility to operate WMAS in the 6 GHz band to Part 74 licensees,<sup>187</sup> we note that unlicensed WMAS are not authorized in the 6875-6900 MHz and 7100-7125 MHz bands since only entities with a Part 74 license are eligible to operate wireless microphones in those bands.

52. We disagree with Microsoft that we should prohibit unlicensed WMAS in the TV bands due to the potential impact on white space devices, particularly personal/portable devices.<sup>188</sup> As an initial matter, there are currently no certified personal/portable white space devices. However, our decision to allow unlicensed WMAS in the TV bands does not change the relationship between any future personal/portable white space devices and unlicensed wireless microphones. That is, both types of devices must share spectrum in the TV bands on an equal basis; neither type of device has priority over the other. As discussed below, unlicensed WMAS will operate with no greater power than the rules currently permit for two narrowband unlicensed wireless microphones, so the impact of unlicensed WMAS on white space devices will be no greater than two narrowband wireless microphones, and will be significantly less than if many narrowband wireless microphones operate simultaneously within a single TV channel as the rules currently permit. Because personal/portable white space devices may operate with up to 100 milliwatts EIRP in the TV bands, the same maximum power at which unlicensed WMAS could operate, personal/portable white space devices would have at least as much impact on unlicensed WMAS as unlicensed WMAS would have on personal/portable white space devices.<sup>189</sup> There is no expectation under the rules that unlicensed WMAS would have priority over other unlicensed uses, such

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<sup>183</sup> Shure Comments at 5.

<sup>184</sup> Sennheiser Comments at 8.

<sup>185</sup> Lectrosonics Reply at 3; ViacomCBS Reply at 7.

<sup>186</sup> 47 CFR § 15.5.

<sup>187</sup> NCTA Reply at 6-7.

<sup>188</sup> Microsoft Comments at 15.

<sup>189</sup> 47 CFR § 15.709(a)(2)(ii).

as white space devices.<sup>190</sup> In the event of a conflict between two unlicensed devices, the device operators would have to resolve the conflict among themselves by taking actions such as changing the operating channel, reorienting antennas, or changing location.<sup>191</sup>

53. We also disagree with Microsoft that we need to consider this proceeding simultaneously with the 2017 wireless microphones notice of proposed rulemaking that sought comment on whether the Commission should expand the eligibility for a Part 74 license to additional entities, e.g., those that routinely use fewer than 50 wireless microphones.<sup>192</sup> In the event the Commission decides to expand eligibility for Part 74 licensing, that action would increase the number of parties eligible to register wireless microphones for protection in the white space database and thus could increase the number of TV channels reserved for licensed wireless microphones in the database.<sup>193</sup> However, our decision to allow unlicensed WMAS in the TV bands does not increase the number of parties eligible to register wireless microphones and, therefore will not increase the total number of TV channels reserved in the database. If the Commission expands licensing eligibility, the procedure for registering a WMAS on a TV channel by newly eligible entities would be no different than the procedure for registering narrowband wireless microphones. In either case, the registration process reserves an entire TV channel regardless of whether a party registers a single narrowband wireless microphone or a WMAS that fills an entire 6-megahertz channel.<sup>194</sup> Because of the increased spectral efficiency provided by WMAS, i.e., more wireless microphones in a single TV channel, WMAS could actually reduce the number of TV channels that must be reserved in the white space database, thus leaving more vacant channels available for white space devices.

#### b. Technical requirements

54. *Bandwidth.* Consistent with our actions with respect to licensed WMAS, we permit unlicensed WMAS to operate in the VHF-TV and UHF-TV bands with a maximum bandwidth of 6 megahertz, which corresponds to the size of a TV channel. Also consistent with our actions with respect to licensed WMAS, we will require unlicensed WMAS devices to operate entirely within a single 6 megahertz channel and not span parts of two adjacent channels to promote more efficient spectrum sharing between narrowband wireless microphones, WMAS, and white space devices. We will also permit unlicensed WMAS to operate within the 6-megahertz portion of the 600 MHz duplex gap (657-663 MHz) that is available to unlicensed wireless microphones. As with licensed WMAS, we do not specify a minimum bandwidth for unlicensed WMAS because some parties may choose to operate systems with smaller bandwidths (e.g., one or two megahertz, as suggested by Shure), and we do not wish to preclude WMAS technical advancements that could allow it to operate more efficiently with smaller bandwidths. Thus, Shure will be able to operate its WMAS system under the rules we adopt, subject to the power limits discussed below. Because many wireless microphones used in unlicensed applications are identical to those used in licensed applications (except for the maximum allowable power in the UHF TV band), establishing the same technical requirements for wireless microphones under both Parts 74 and 15 of the rules will enable manufacturers to produce wireless microphones at lower cost since they will not have develop multiple variations to comply with differing regulatory requirements.

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<sup>190</sup> 47 CFR § 15.5.

<sup>191</sup> *Id.*

<sup>192</sup> Microsoft Comments at 15; *See Wireless Microphones Order on Reconsideration*, 32 FCC Rcd at 6123-25, paras. 85-90.

<sup>193</sup> Parties operating Part 74 licensed wireless microphones may register their location, operating channel(s) and times of operation in the white space database to receive protection from unlicensed white space devices. 47 CFR §§ 15.712(f); 15.713(b)(2)(ii), (j)(8); 15.715(d).

<sup>194</sup> 15.713(j)(8)(vi). This section requires licensed wireless microphone registrations to specify the TV channels used by licensed wireless microphones but does not have provisions for specifying less than a full TV channel.

55. We disagree with Shure/NAB/Paramount that all unlicensed WMAS systems should be limited to a channel size of only one or two megahertz to enable coexistence with narrowband wireless microphones.<sup>195</sup> Such a restriction could severely limit the maximum number of audio channels that an unlicensed WMAS could use, and we note that other wireless microphone manufacturers, such as Sennheiser, are developing systems that operate across the full 6 megahertz TV channel bandwidth.<sup>196</sup> Limiting the maximum permissible bandwidth of unlicensed WMAS to one or two megahertz would not ensure that portions of a vacant TV channel remain available for licensed narrowband wireless microphones since an unlicensed WMAS operator could simply use multiple one or two megahertz systems and occupy an entire 6-megahertz TV channel. For users that require many microphones, and depending on the usage requirements and operating protocols, employing WMAS over a wider bandwidth channel may permit more microphones to share that single channel than could operate on multiple smaller adjacent WMAS channels within that single TV channel.<sup>197</sup> Thus, permitting WMAS to operate on channels up to 6 megahertz bandwidth can promote spectrum efficiency by allowing wireless microphones to operate using fewer TV channels than they do now since a WMAS system on a single 6 megahertz channel could have the same or greater capacity than multiple narrowband wireless microphones using multiple TV channels. This can leave more spectrum available for other wireless microphone users, as well as other spectrum users, e.g., white space devices.

56. We do not believe that an unlicensed WMAS bandwidth restriction is necessary to enable spectrum sharing between unlicensed WMAS and narrowband wireless microphones used in electronic news gathering, as NAB suggests.<sup>198</sup> Based on the record, we expect that WMAS will generally be relatively expensive and complex systems designed for events, such as concerts and live theater, where large numbers of wireless microphones are used, and it seems unlikely that these systems would be deployed for purposes such as covering breaking news events, where simpler narrowband wireless microphones could be deployed more quickly and easily.<sup>199</sup> Therefore, we expect that conflicts between unlicensed WMAS and nearby narrowband wireless microphones used for electronic news gathering are unlikely to occur. And in instances where such conflicts may occur, we believe that the disparate users should be able to easily coordinate usage as both WMAS and narrowband microphones are generally designed with capability to operate over multiple channels.

57. We disagree that the brief operational tests performed by Shure and NAB/Paramount demonstrate that unlicensed WMAS must be limited to a 1 or 2 megahertz bandwidth.<sup>200</sup> We do not believe that this brief test, in which it appears that Sennheiser's prototype 6-megahertz wide WMAS was placed within a few meters of a narrowband wireless microphone receiver<sup>201</sup> and resulted in purported harmful interference at extremely short separation distances, demonstrates a need to limit unlicensed WMAS bandwidth. It also appears that NAB's claim that interference could occur to licensed narrowband wireless microphones at 55 meters from unlicensed WMAS is an unlikely occurrence.<sup>202</sup> As

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<sup>195</sup> Shure/NAB/Paramount Nov. 3, 2022 *ex parte* at 2; NAB/Paramount June 2, 2023 *ex parte* at 4.

<sup>196</sup> Sennheiser Comments at 7; Waves Reply at 5.

<sup>197</sup> For example, multiple separate wireless microphone systems sharing a single TV channel can produce intermodulation products that limit spectrum use, whereas a single wider bandwidth system could be designed to minimize these effects.

<sup>198</sup> NAB/Paramount June 2, 2023 *ex parte* at 3.

<sup>199</sup> Sennheiser June 22, 2023 *ex parte* at 9.

<sup>200</sup> NAB/Paramount June 2, 2023 *ex parte* at 2.

<sup>201</sup> *Id.* NAB/Paramount did not state the distance at which interference occurred. Sennheiser states that its WMAS was placed within two meters of the narrowband wireless microphone system which received interference. Sennheiser June 22, 2023 *ex parte* at 6.

<sup>202</sup> NAB/Paramount June 2, 2023 *ex parte* at 3.

Sennheiser notes, NAB's assumed 20 meter or more distance from a narrowband ENG wireless microphone to its associated receiver seems atypical for newsgathering applications.<sup>203</sup> Assuming a much shorter separation distance, such as 3 to 5 meters, which Sennheiser suggests is more realistic, drastically reduces the distance at which interference could occur to narrowband microphone systems from WMAS.<sup>204</sup> Also, parties operating narrowband wireless microphones in the UHF-TV band on a licensed basis are permitted to operate with up to 250 milliwatts rather than 50 milliwatts as NAB assumed.<sup>205</sup> Further, since WMAS would typically be used at locations such as theaters and concert halls, the emissions are generally expected to be attenuated from building walls between an unlicensed WMAS and narrowband wireless microphones used in ENG, further reducing the likelihood of harmful interference.

58. *Spectral efficiency.* We adopt the same spectral efficiency requirement for unlicensed WMAS that we adopt for licensed WMAS to help ensure consistent requirements between licensed and unlicensed WMAS. That is, an unlicensed WMAS must have an operational mode capable of providing at least three audio channels per megahertz, but we do not require unlicensed WMAS to operate with a specific minimum number of audio channels at all times. As discussed above with respect to licensed WMAS, because of WMAS' dynamic capabilities, a single spectral usage metric would not be appropriate since the number and quality of audio channels can vary during an event and may not equal or exceed a specific threshold, e.g., three audio channels in every megahertz of spectrum at every instance in time. However, as Sennheiser indicates, WMAS spectral efficiency would typically be significantly greater than the three audio channel per megahertz benchmark that we adopt.<sup>206</sup> For these reasons, we decline to adopt a specific spectral efficiency metric that must be met at all times, e.g., 4 audio channels per megahertz as suggested by Shure/NAB Paramount.<sup>207</sup> We instead require unlicensed WMAS to incorporate an operational mode with the capability of operating with three audio channels per megahertz.

59. *Power.* We adopt power levels for unlicensed WMAS to permit them to operate using different technologies developed by different manufacturers, e.g., Shure and Sennheiser. We permit unlicensed WMAS in the TV bands with a bandwidth of up to 1 megahertz to operate at 50 milliwatts EIRP, which is the same power level currently permitted for narrowband unlicensed wireless microphones operating with a bandwidth of 200 kHz.<sup>208</sup> For unlicensed WMAS in the TV bands with a bandwidth of 1 to 2 megahertz, we permit operation at up to 100 milliwatts EIRP, which is the same as the power level permitted by the current rules for two narrowband unlicensed wireless microphones, but is less than the 250 milliwatt power level permitted for licensed wireless microphones in the UHF TV band.<sup>209</sup> This higher power level is supported by Shure and NAB/Paramount (subject to the bandwidth restrictions discussed above), and Sennheiser does not object to it.<sup>210</sup> For unlicensed WMAS bandwidths greater than 2 megahertz and up to 6 megahertz in the TV bands, we permit a maximum of 100 milliwatts EIRP. While this power level is 3 dB greater than the 50 milliwatt level for which the Commission

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<sup>203</sup> Sennheiser June 22, 2023 *ex parte* at 4.

<sup>204</sup> *Id.* at 5.

<sup>205</sup> 47 CFR § 74.861(e)(1)(ii).

<sup>206</sup> Sennheiser Comments at 4, 6.

<sup>207</sup> Shure/NAB/Paramount Nov. 3, 2022 *ex parte* at 2

<sup>208</sup> 47 CFR § 15.236(d)(1). Historically, the power limit for unlicensed wireless microphones has always been lower than the limit for licensed wireless microphones. This is consistent with unlicensed use under part 15 where the users are not known and we rely primarily on the device's technical limits to avoid causing harmful interference to authorized users, as opposed to licensed use under part 74 where the users are known through the licensing process so that additional coordination steps can be taken between known users, if necessary.

<sup>209</sup> *See id.*; 47 CFR § 74.861(e)(1)(ii).

<sup>210</sup> Shure/NAB/Paramount Nov. 3, 2022 *ex parte* at 2; NAB/Paramount June 2, 2023 *ex parte* at 4; Sennheiser June 27, 2023 *ex parte* at 2.

sought comment, we adopt it because it will, allow manufacturers with different system designs (e.g., Sennheiser's with a single power level over 6 megahertz and Shure's where the power scales with bandwidth) to market unlicensed WMAS systems.<sup>211</sup> Even at the slightly higher power levels we adopt, unlicensed WMAS will still operate at a significantly lower power spectral density than if multiple narrowband wireless microphones occupied an entire 6-megahertz TV channel, and the higher spectral efficiency of WMAS will permit a greater number of audio channels in a 6-megahertz TV channel than if multiple narrowband wireless microphones are used. This reduced power spectral density compared to narrowband wireless microphones will keep the potential for causing harmful interference low and promote coexistence with other spectrum users. For unlicensed WMAS operating in the upper 6-megahertz segment of the duplex gap (657-663 MHz), we are retaining the maximum 20 milliwatt EIRP limit consistent with the power level currently permitted for narrowband wireless microphones in this frequency band.<sup>212</sup> No party requested a different power level for that band.

60. *Emission mask and spurious emission limits.* Consistent with our action with respect to Part 74 licensed WMAS, we will require unlicensed WMAS to comply with the emission mask and spurious emission limits in the 2021 ETSI standard.<sup>213</sup> These limits will ensure that WMAS protects operations in adjacent bands, including the broadcast TV bands. This action will ensure consistent requirements for both licensed and unlicensed WMAS, which will benefit manufacturers and WMAS users by eliminating the need for manufacturers to design multiple equipment models to comply with differing standards, thus reducing equipment costs.

## 2. Updated ETSI standards for Part 15

61. We adopt the same emission masks for unlicensed analog and digital narrowband (i.e., non-WMAS) wireless microphones as we do for Part 74 licensed wireless microphones, specifically, those in the 2021 ETSI standard. As with our action harmonizing the emission masks for licensed and unlicensed WMAS, this action will ensure consistency in the requirements for both licensed and unlicensed narrowband wireless microphones, which will benefit manufacturers and narrowband wireless microphone users by eliminating the need for manufacturers to design multiple equipment models to comply with varying standards, thus reducing equipment costs.

### D. Updating Wireless Microphone Rules Following the End of the Post-Incentive Auction Transition

62. In the *Notice*, the Commission proposed and sought comment on which Part 74 and Part 15 wireless microphone rules should be updated to reflect the end of the 39-month post-Incentive Auction transition period.<sup>214</sup> Wireless microphones, both licensed and unlicensed, were previously permitted to operate in the 600 MHz band (former TV channels 38-51) that was reallocated for wireless services in the *Incentive Auction R&O*.<sup>215</sup> The Commission established a 39-month period during which TV stations would transition out of the 600 MHz band, and decided that wireless microphones would no longer be able to operate in the 600 MHz service band after this transition period, although they could still operate in the 600 MHz guard band and duplex gap.<sup>216</sup> After the end of the transition period on July 13, 2020, wireless microphone operations in the 600 MHz band are limited to segments of the 600 MHz guard band

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<sup>211</sup> *Notice*, 36 FCC Rcd at 7926, para. 45.

<sup>212</sup> 47 CFR § 15.236(d)(2).

<sup>213</sup> ETSI EN 300 422-1 (2021), Section 4.2.4.2.2 at 20; ETSI EN 300 422-1 (2021), Section 4.2.4.1.2 at 18.

<sup>214</sup> *Notice*, 36 FCC Rcd at 7928-29, paras. 50-53.

<sup>215</sup> *See generally*, *Incentive Auction R&O*, 29 FCC Rcd 6567.

<sup>216</sup> *Incentive Auction R&O*, 29 FCC Rcd at 6845-46, paras. 684, 687.

and 600 MHz duplex gap, as specified in the Part 15 and 74 rules.<sup>217</sup>

63. *Part 74.* The Commission proposed several specific changes to the Part 74 rules in the *Notice*.<sup>218</sup> Specifically, it proposed to modify the section 74.802(a) frequency list by removing the 614-698 MHz band (former TV channels 38 to 51) and replacing it with the 653-657 MHz band (a segment of the 600 MHz duplex gap), which is the only portion of the 600 MHz band now available under Part 74.<sup>219</sup> The Commission also proposed to modify the technical requirements in section 74.861(e)(1) to remove the reference to the 614-698 MHz band in paragraph (ii) and to add, in paragraph (iii), the frequency band for the duplex gap segment where wireless microphones can operate.<sup>220</sup> It also noted that a number of Part 74 rules specify deadlines related to the post-Incentive Auction transition or other rule changes that have since passed.<sup>221</sup> For example, sections 74.802(f) and 74.851(i)-(l) contain provisions related to the now ended 600 MHz band transition, section 74.870(c) lists 600 MHz band frequencies for Wireless Video Assist devices that are no longer available after the end of the transition, and sections 74.861(d)(3), (e)(6), and 74.870(i) contain transition dates that have passed.<sup>222</sup> No parties objected to these proposals.

64. We make changes to sections 74.802(a), 74.861(e)(1) and 74.870(c) to reflect the frequencies currently available for low power auxiliary stations. We also modify section 74.802(b)(1) by removing the entries for analog TV stations from the table of TV service contours that licensed wireless microphones must protect and correcting the upper channel number of the UHF-TV band.<sup>223</sup> Because all analog TV broadcasting ceased in 2021, it is no longer necessary to specify these contours, and the upper channel in the UHF-TV band is now channel 36.<sup>224</sup> However, we will not at this time make additional revisions to the Part 74 rules to remove all paragraphs with transition dates that have passed. It is possible that there are parties still in possession of wireless microphones that can no longer be used because they operate on frequencies where operation is now prohibited, e.g., the 600 MHz service bands, and retaining the rules with the transition requirements can enable parties to more easily determine which equipment may or may not be used now.

65. *Part 15.* The Commission proposed to make certain edits to the Part 15 rules to remove unnecessary references to transition dates that have passed and to make the rules clearer and easier to follow.<sup>225</sup> Specifically, with regard to section 15.236, it proposed to amend paragraph (a) to remove the definition for the 600 MHz service band since it is no longer available for wireless microphone use, as well as the definition of Spectrum Act, since it is not referenced anywhere else in this rule section.<sup>226</sup> The Commission also proposed to remove paragraph (c)(2), which lists the 600 MHz service band as being available for unlicensed wireless microphones, and paragraph (e)(2), which lists the minimum required

<sup>217</sup> *Channel Reassignment Public Notice*, 32 FCC Rcd at 2807, para. 68; 47 CFR §§ 15.236(c)(3), (5); 74.802(a)(2).

<sup>218</sup> *Notice*, 36 FCC Rcd at 7928, para. 51.

<sup>219</sup> *Notice*, 36 FCC Rcd at 7928, para. 51 (citing 47 CFR § 74.802(a)). The Commission proposed to eliminate paragraph (a)(2) and re-number paragraph (a)(1) to (a). *Id.* at 7928, para. 51 n.128.

<sup>220</sup> *Notice*, 36 FCC Rcd at 7928, para. 51 (citing 47 CFR § 74.861(e)(1)(ii)-(iii)).

<sup>221</sup> *Notice*, 36 FCC Rcd at 7928, para. 51.

<sup>222</sup> *Notice*, 36 FCC Rcd at 7928, para. 51 (citing 47 CFR §§ 74.802(f), 74.851(i)-(l), 74.861(d)(3), (e)(6), 74.870(c), (i)).

<sup>223</sup> 47 CFR § 74.802(b)(1).

<sup>224</sup> *See Media Bureau Reminds Low Power Television and Television Translator Stations that the July 13, 2021, Digital Transition Date and Other Important Deadlines are One Week Away*, Public Notice, 36 FCC Rcd 10364 (MB 2021).

<sup>225</sup> *Notice*, 36 FCC Rcd at 7929, para. 52.

<sup>226</sup> *Notice*, 36 FCC Rcd at 7929, para. 52 (citing 47 CFR § 15.236(a)(4)-(5)). The Commission also proposed to remove the unnecessary note between these paragraphs. *Id.*

separation distances from 600 MHz service band licensees, and also proposed to modify paragraph (d)(1) to remove a reference to the 600 MHz service band.<sup>227</sup> It further proposed to remove section 15.236(c)(6) which requires that prior to operation in the 600 MHz service band, the 600 MHz guard band(s), or the 600 MHz duplex gap, wireless microphone users must rely on the white space database to determine that their intended operating frequencies are available for unlicensed wireless microphone operation at the location where they will be used, and to make corresponding revisions to the white space rules to reflect the removal of this section.<sup>228</sup> The Commission also proposed to remove section 15.37(i) (transition provisions for compliance with modified wireless microphone rules) since the certification, manufacturing, marketing, and operational cutoff dates have all passed and there does not appear to be a need to retain this section.<sup>229</sup> It further proposed to remove section 15.37(k) (disclosure requirements for unlicensed wireless microphones capable of operating in the 600 MHz service band) since all marketing of unlicensed wireless microphones that operate in the 600 MHz service band is now prohibited, so there does not appear to be a need for this rule on consumer disclosure.<sup>230</sup> No parties objected to these proposals.

66. We adopt the proposals to modify section 15.236 to reflect the currently available frequencies for unlicensed wireless microphones, except we are making additional modifications to section 15.236(e) by removing the entries for analog TV stations from the table of TV service contours that unlicensed wireless microphones must protect and correcting the upper channel number of the UHF-TV band.<sup>231</sup> All analog TV broadcasting ceased in 2021, so it is no longer necessary to specify these contours, and the highest channel in the UHF-TV band is now channel 36.<sup>232</sup> Consistent with our actions with respect to licensed wireless microphones, we retain the transition requirements in section 15.37 so parties can more easily determine which wireless microphones comply with the current rules, e.g., permissible frequencies of operation.

67. With regard to removing section 15.236(c)(6), the Spectrum Act states that operation of unlicensed devices in the 600 MHz guard bands “shall rely on a database or subsequent methodology as determined by the Commission.”<sup>233</sup> We are removing the database access requirement for unlicensed wireless microphones operating in the guard bands (including the duplex gap) as no longer necessary since these bands are now unavailable to licensed services nationwide. We believe that this constitutes a “subsequent methodology” that will ensure that unlicensed wireless microphones do not cause harmful interference to licensed services, thus complying with the Spectrum Act requirements.<sup>234</sup> Consistent with removing the database access requirement for unlicensed wireless microphones, we also remove references to this requirement in sections 15.703, 15.713 and 15.715 of the white space rules.

#### IV. PROCEDURAL MATTERS

68. *Final Regulatory Flexibility Analysis.* The Regulatory Flexibility Act of 1980, as amended

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<sup>227</sup> Notice, 36 FCC Rcd at 7929, para. 52 (citing 47 CFR § 15.236(c)(2), (d)(1), (e)(2)).

<sup>228</sup> Notice, 36 FCC Rcd at 7929, para. 52 (citing 47 CFR §§ 15.236(c)(6), 15.703, 15.713, 15.715).

<sup>229</sup> Notice, 36 FCC Rcd at 7929, para. 52 (citing 47 CFR § 15.37(i)).

<sup>230</sup> Notice, 36 FCC Rcd at 7929, para. 52 (citing 47 CFR § 15.37(k)).

<sup>231</sup> 47 CFR § 15.236(e).

<sup>232</sup> See *Media Bureau Reminds Low Power Television and Television Translator Stations that the July 13, 2021, Digital Transition Date and Other Important Deadlines are One Week Away*, Public Notice, 36 FCC Rcd 10364 (MB 2021).

<sup>233</sup> 47 U.S.C. § 1454(d).

<sup>234</sup> 47 U.S.C. § 1454(d), (e).

(RFA),<sup>235</sup> 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.”<sup>236</sup> Accordingly, we have prepared a Final Regulatory Flexibility Analysis (FRFA) concerning the possible impact of the rule changes contained in this Report and Order on small entities. The FRFA is set forth in Appendix C.

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

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

71. *People with Disabilities.* To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to [fcc504@fcc.gov](mailto:fcc504@fcc.gov) or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (TTY).

72. *Contact Persons.* For additional information concerning this Report and Order, please contact Mr. Hugh L. Van Tuyl at 202-418-7506 or [Hugh.VanTuyl@fcc.gov](mailto:Hugh.VanTuyl@fcc.gov).

## V. ORDERING CLAUSES

73. Accordingly, IT IS ORDERED that, pursuant to the authority contained in sections 4(i), 301, 302, and 303 of the Communications Act of 1934, as amended, and sections 6403 and 6407 of the Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, 126 Stat. 156, 47 U.S.C. §§ 154(i), 301, 302a, 303, 1452, 1454, this Report and Order IS HEREBY ADOPTED.

74. IT IS FURTHER ORDERED that parts 15 and 74 of the Commission’s rules ARE AMENDED as specified in Appendix A, and such rule amendments WILL BECOME EFFECTIVE 30 days after the date of publication in the *Federal Register*.

75. IT IS FURTHER ORDERED that the Commission’s Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of the Report and Order, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

76. IT IS FURTHER ORDERED that the Office of the Managing Director, Performance Program Management, SHALL SEND a copy of this Report and Order in a report to be sent to Congress and the Government Accountability Office pursuant to the Congressional Review Act, 5 U.S.C. § 801(a)(1)(A).

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch

<sup>235</sup> 5 U.S.C. §§ 601–612. The RFA has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996).

<sup>236</sup> *See* 5 U.S.C. § 605(b).



Secretary

## Appendix A

## Final Rules

Parts 15 and 74 of the Code of Federal Regulations is amended as follows:

**PART 15 – RADIO FREQUENCY DEVICES**

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

**AUTHORITY:** [TO BE INSERTED PRIOR TO PUBLICATION OF SUMMARY IN FEDERAL REGISTER.].

1. Amend section 15.38 by revising paragraph (d) to read as follows:

**§ 15.38 Incorporation by reference.**

\* \* \* \* \*

(d) The following document is available from the European Telecommunications Standards Institute (ETSI), 650 Route des Lucioles, F-06921 Sophia Antipolis Cedex, France, or at [https://www.etsi.org/deliver/etsi\\_en/300400\\_300499/30042201/02.02.01\\_60/en\\_30042201v020201p.pdf](https://www.etsi.org/deliver/etsi_en/300400_300499/30042201/02.02.01_60/en_30042201v020201p.pdf).

(1) ETSI EN 300 422-1 V2.2.1 (2021-11): “*Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum,*” Copyright 2021, IBR approved for § 15.236(g).

(2) [Reserved]

\* \* \* \* \*

2. Amend section 15.236 by revising the title and paragraphs (a), (b), (c), (d)(1), (e), (f), and (g) to read as follows:

**§ 15.236 Operation of wireless microphones in the bands 54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz, 614-616 MHz and 657-663 MHz.**

(a) *Definitions.* The following definitions apply in this section.

*600 MHz duplex gap.* An 11 megahertz guard band at 652-663 MHz that separates part 27 600 MHz service uplink and downlink frequencies.

*600 MHz guard band.* Designated frequency band at 614-617 MHz that prevents interference between licensed services in the 600 MHz service band and channel 37.

*Wireless Microphone.* An intentional radiator that converts sound into electrical audio signals that are transmitted using radio signals to a receiver which converts the radio signals back into audio signals that are sent through a sound recording or amplifying system. Wireless microphones may be used for cue and control communications and synchronization of TV camera signals as defined in § 74.801 of this chapter. Wireless microphones do not include auditory assistance devices as defined in § 15.3(a) of this part.

*Wireless Multichannel Audio Systems.* Wireless audio transmission systems using broadband digital transmission techniques for microphone and in-ear monitor system applications and other multichannel audio use.

(b) Operation under this section is limited to wireless microphones and wireless multichannel audio systems as defined in this section.

(c) Operation of wireless microphones is permitted in all of the following frequency bands. Wireless multichannel audio systems may operate only in the bands listed in paragraphs (1) and (2).

- (1) Channels allocated and assigned for the broadcast television service.
- (2) The 657-663 MHz segment of the 600 MHz duplex gap.
- (3) The 614-616 MHz segment of the 600 MHz guard band.
- (d) \* \* \*

(1) In the bands allocated and assigned for broadcast television:

- (i) Wireless microphones: 50 mW EIRP.
- (ii) Wireless multichannel audio systems with a bandwidth up to 1 MHz: 50 mW EIRP.
- (iii) Wireless multichannel audio systems with a bandwidth greater than 1 MHz: 100 mW EIRP.

(2) \* \* \*

(e) Operation is limited to locations at least four kilometers outside the following protected service contours of co-channel TV stations:

Type of station	Protected contour		
	Channel	Contour (dBu)	Propagation curve
Digital: Full service TV, Class A TV, LPTV, translator and booster	Low VHF (2-6)	28	F(50,90)
	High VHF (7-13)	36	F(50,90)
	UHF (14-36)	41	F(50,90)

(f) *Operating frequency and bandwidth*

(1) *Wireless microphones.* The operating frequency within a permissible band of operation defined in paragraph (c) must comply with the following requirements.

- (i) The frequency selection shall be offset from the upper or lower band limits by 25 kHz or an integral multiple thereof.
- (ii) One or more adjacent 25 kHz segments within the assignable frequencies may be combined to form a channel whose maximum bandwidth shall not exceed 200 kHz. The operating bandwidth shall not exceed 200 kHz.
- (iii) The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.005\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. Battery operated equipment shall be tested using a new battery.

(2) *Wireless multichannel audio systems.* A wireless multichannel audio system may have an operating bandwidth not exceeding 6 megahertz and must have a mode of operation in which it is capable of operating with at least three audio channels per megahertz. For wireless multichannel audio systems operating in the TV bands (channels 2-36), the 6 megahertz (or less) channel must fall entirely within a single TV channel.

(g) *Emission masks.*

(1) *Analog systems.* Emissions within the band from  $2.5 \times B$  below to  $2.5 \times B$  above the carrier frequency, where B is the channel bandwidth, shall comply with the emission mask in Figure 1 of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz*;

*Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

(2) *Digital systems.* Emissions within the band from 2.5 x B below to 2.5 x B above the carrier frequency, where B is the channel bandwidth, shall comply with the emission mask in Figure 2 of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

(3) *Wireless Multichannel Audio Systems.* Emissions within the band from 2.5 x B below to 2.5 x B above the carrier frequency, where B is the channel bandwidth, shall comply with the emission mask in Figure 3 of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

(4) *Spurious emission limits.* Emissions outside of the emission masks listed in paragraphs (g)(1) through (g)(3) shall comply with the limits specified in section 4.2.4.1.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

3. Amend section 15.703 by revising the definition of “white space database” to read as follows:

**§ 15.703 Definitions.**

\* \* \* \* \*

*White space database.* A database system approved by the Commission that maintains records on authorized services and provides lists of available channels to white space devices.

4. Amend section 15.713 by removing and reserving paragraph (a)(2), revising paragraph (a)(3) and removing and reserving paragraphs (f) and (i) to read as follows:

**§ 15.713 White space database.**

(a) \* \* \*

(2) [Reserved]

(3) To register the identification information and location of fixed white space devices.

\* \* \* \* \*

(f) [Reserved]

\* \* \* \* \*

(i) [Reserved]

\* \* \* \* \*

5. Amend section 15.715 by removing paragraph (q).

**Part 74 – EXPERIMENTAL RADIO, AUXILIARY, SPECIAL BROADCAST AND OTHER PROGRAM DISTRIBUTION SERVICES**

6. The authority citation for part 74 continues to read as follows:

AUTHORITY: [TO BE INSERTED PRIOR TO PUBLICATION OF SUMMARY IN FEDERAL REGISTER.].

7. Amend section 74.801 by adding a definition of “Wireless Multichannel Audio System” to read as follows:

**§ 74.801 Definitions**

\* \* \* \* \*

*Wireless Multichannel Audio Systems.* Wireless audio transmission systems using broadband digital transmission techniques for microphone and in-ear monitor system applications and other multichannel audio use.

8. Amend section 74.802 by revising paragraphs (a) and (b)(1) to read as follows:

**§ 74.802 Frequency assignment.**

(a) Frequencies within the following bands may be assigned for use by low power auxiliary stations:

- 26.100-26.480 MHz
- 54.000-72.000 MHz
- 76.000-88.000 MHz
- 161.625-161.775 MHz (except in Puerto Rico or the Virgin Islands)
- 174.000-216.000 MHz
- 450.000-451.000 MHz
- 455.000-456.000 MHz
- 470.000-488.000 MHz
- 488.000-494.000 MHz (except Hawaii)
- 494.000-608.000 MHz
- 653.000-657.000 MHz
- 941.500-944.000 MHz
- 944.000-952.000 MHz
- 952.850-956.250 MHz
- 956.45-959.85 MHz
- 1435-1525 MHz
- 6875.000-6900.000 MHz
- 7100.000-7125.000 MHz

(b)(1) Operations in the bands allocated for TV broadcasting are limited to locations at least 4 kilometers outside the protected contours of co-channel TV stations shown in the following table. These contours are calculated using the methodology in § 73.684 of this chapter and the R-6602 curves contained in § 73.699 of this chapter.

Type of station	Protected contour		
	Channel	Contour (dBu)	Propagation curve
Digital: Full service TV, Class A TV, LPTV, translator and booster	Low VHF (2-6)	28	F(50,90)
	High VHF (7-13)	36	F(50,90)

	UHF (14-36)	41	F(50,90)
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(2) \* \* \*

9. Amend section 74.861 by revising paragraphs (d)(4), (e)(1), (e)(5), (e)(7) and (i)(1) to read as follows:

**§ 74.861 Technical requirements.**

\* \* \* \* \*

(d) \* \* \*

(4) The following emission limits apply in the 941.5-944 MHz, 944-952 MHz, 952.850-956.250 MHz, 956.45-959.85 MHz, 1435-1525 MHz, 6875-6900 MHz and 7100-7125 MHz bands.

(i) *Analog systems.* Emissions within the band from 2.5 x B below to 2.5 x B above the carrier frequency, where B is the channel bandwidth, shall comply with the emission mask in Figure 1 of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

(ii) *Digital systems.* Emissions within the band from 2.5 x B below to 2.5 x B above the carrier frequency, where B is the channel bandwidth, shall comply with the emission mask in Figure 2 of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

(iii) *Wireless Multichannel Audio Systems.* Emissions within the band from 2.5 x B below to 2.5 x B above the carrier frequency, where B is the channel bandwidth, shall comply with the emission mask in Figure 3 of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.* A wireless multichannel audio system must have an operating bandwidth B not exceeding 20 megahertz and must have a mode of operation in which it is capable of transmitting at least three audio channels per megahertz.

(iv) *Spurious emission limits.* Emissions outside of the emission masks specified in paragraphs (d)(4)(i) through (d)(4)(iii) shall comply with the limits specified in section 4.2.4.1.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

(e) \* \* \*

(1) \* \* \*

(i) 54-72, 76-88, and 174-216 MHz bands: 50 mW EIRP

(ii) 470-608 MHz band: 250 mW conducted power

(iii) 653-657 MHz band: 20 mW EIRP

\* \* \* \* \*

(5) The operating bandwidth shall not exceed 200 kilohertz, except that a wireless multichannel audio system must have an operating bandwidth not exceeding 6 megahertz in the TV bands or 4 megahertz in the 653-657 MHz band and must have a mode of operation in which it is capable of transmitting at least three audio channels per megahertz. For wireless multichannel audio systems operating in the TV bands, the 6 megahertz (or less) channel must fall entirely within a single TV channel (2-36) that is available for

Part 74 LPAS use under § 74.802(b). The provisions of § 74.802(c) regarding frequency of operation within TV channels do not apply to wireless multichannel audio systems.

(6) \* \* \*

(7) *Emission masks.*

(i) *Analog systems.* Emissions within the band from  $2.5 \times B$  below to  $2.5 \times B$  above the carrier frequency, where B is the channel bandwidth, shall comply with the emission mask in Figure 1 of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

(ii) *Digital systems.* Emissions within the band from  $2.5 \times B$  below to  $2.5 \times B$  above the carrier frequency, where B is the channel bandwidth, shall comply with the emission mask in Figure 2 of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

(iii) *Wireless Multichannel Audio Systems.* Emissions within the band from  $2.5 \times B$  below to  $2.5 \times B$  above the carrier frequency, where B is the channel bandwidth, shall comply with the emission mask in Figure 3 of section 4.2.4.2.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

(iv) *Spurious emission limits.* Emissions outside of the emission masks listed in paragraphs (e)(7)(i) through (e)(7)(iii) shall comply with the limits specified in section 4.2.4.1.2 of ETSI EN 300 422-1 V2.2.1 (2021-11), *Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum.*

\* \* \* \* \*

(i) \* \* \*

(1) The following document is available from the European Telecommunications Standards Institute (ETSI), 650 Route des Lucioles, F-06921 Sophia Antipolis Cedex, France, or at [https://www.etsi.org/deliver/etsi\\_en/300400\\_300499/30042201/02.02.01\\_60/en\\_30042201v020201p.pdf](https://www.etsi.org/deliver/etsi_en/300400_300499/30042201/02.02.01_60/en_30042201v020201p.pdf).

(i) ETSI EN 300 422-1 V2.2.1 (2021-11): “*Wireless Microphones; Audio PMSE up to 3 GHz; Part 1: Audio PMSE Equipment up to 3 GHz; Harmonised Standard for access to radio spectrum,*” Copyright 2021, IBR approved for §§ 74.861(d)(4) and 74.861(e)(7).

(ii) [Reserved]

10. Amend section 74.870 by revising paragraph (c) introductory text to read as follows:

**§ 74.870 Wireless video assist devices.**

\* \* \* \* \*

(c) Wireless video assist devices may operate with a bandwidth not to exceed 6 MHz on frequencies in the bands 180-210 MHz (TV channels 8-12) and 470-608 MHz (TV channels 14-36) subject to the following restrictions:

(1) \* \* \*

\* \* \* \* \*

**Appendix B****List of Parties Filing Comments**Comments

1. Aerospace and Flight Test Radio Coordinating Council, Inc. (AFTRCC)
2. Cisco Systems, Inc. and Facebook, Inc. (Joint Filers)
3. Microsoft Corporation (Microsoft)
4. National Association of Broadcasters (NAB)
5. National Telecommunications and Information Administration (NTIA)
6. Sennheiser Electronic Corporation (Sennheiser)
7. Shure Incorporated (Shure)
8. Society of Broadcast Engineers, Incorporated (SBE)
9. Waves Audio Ltd. (Waves)
10. Wi-Fi Alliance

Reply comments (due August 30, 2021)

1. Cisco Systems, Inc., Facebook, Inc., Qualcomm, Inc. and Intel Corporation (Joint Filers)
2. Lectrosonics, Inc.
3. Microsoft Corporation (Microsoft)
4. National Association of Broadcasters (NAB)
5. NCTA – The Internet & Television Association (NCTA)
6. Sennheiser Electronic Corporation (Sennheiser)
7. Shure Incorporated (Shure)
8. ViacomCBS Inc. (ViacomCBS)
9. Waves Audio Ltd. (Waves)