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

In the Matter of)
Replacement of Part 90 by Part 88 to) PR Docket No. 92-235
Revise the Private Land Mobile Radio)
Services and Modify the Policies)
Governing Them)
and)
Examination of Exclusivity and)
Frequency Assignment Policies of)
the Private Land Mobile Radio Services)
Amendment of the Commission's Rules) PR Docket No. 92-257
Concerning Maritime Communications)

MEMORANDUM OPINION AND ORDER

Adopted: December 23, 1996

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By the Commission:

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I. INTRODUCTION AND BACKGROUND

1. On June 15, 1995, the Commission adopted the *Report and Order and Further Notice of Proposed Rule Making* in PR Docket No. 92-235¹ which provides the private land mobile radio (PLMR) community with a regulatory framework that promotes efficient use of spectrum, increases technical flexibility, enhances the deployment of new technologies, and promotes a competitive and robust marketplace for product development. We concluded that changes in the PLMR bands were necessary due to an increasing demand for PLMR services and its associated spectrum congestion.² The *R&O* provides PLMR users with a large choice of options for upgrading existing radio systems and designing future radio systems. Specifically, the *R&O* sets forth a new channel plan that accommodates a broad range of equipment and a transition schedule that requires manufacturers to meet increasingly efficient equipment standards, but does not require users to buy new radios or to change out entire systems. Further, the *R&O* provides a regulatory framework which addressed the diverse communications requirements of both large and small private land mobile users.³

2. We received twenty-four petitions, as well as five oppositions and three replies, requesting that we reconsider or clarify various decisions and technical rules adopted in the *R&O*.⁴ This *Memorandum Opinion and Order (MO&O)* addresses issues and concerns in the petitions. This *MO&O* also addresses a petition for reconsideration filed in PR Docket No. 92-257 regarding the shared use of industrial/land transportation and maritime public correspondence frequencies.⁵ We address this petition here because it concerns technical

¹ *Report and Order and Further Notice of Proposed Rule Making*, PR Docket No. 92-235, 10 FCC Rcd 10076 (1995) (*R&O* and *FNPRM*).

² *See Notice of Proposed Rule Making*, PR Docket No. 92-235, 7 FCC Rcd 8105 (1995) (*Refarming Notice*) at paras. 2 and 4. The PLMR bands that were the focus of the *R&O* are 150-174 MHz, 421-430 MHz, 450-470 MHz, and 470-512 MHz.

³ *See R&O* at paras. 36-37.

⁴ A list of the parties filing petitions, oppositions, and replies is provided in Appendix A.

⁵ *See Amendment of the Commission's Rules Concerning Maritime Communications, First Report and Order*, PR Docket No. 92-257, FCC 95-178, 10 FCC Rcd 8419 (1995). This petition, filed by the Industrial Telecommunications Association, Inc. (ITA), was the only petition for reconsideration filed in this proceeding.

requirements which were the subject of the *R&O*. While we have reviewed all of the suggested changes carefully, only the significant issues raised by the petitioners are discussed in the *MO&O*. We note, however, that those suggestions and requests for clarification which required minor modifications to our rules have been directly incorporated into the final rules without extensive discussion. Specific rule changes are contained in Appendix D. We further note that the action taken in this *MO&O* relates solely to the rules and policies adopted in the *R&O*. The issues of market-based incentives, such as exclusivity with the right to lease excess capacity, spectrum user fees, and competitive bidding, which were the subject of the *Further Notice of Proposed Rule Making* will be addressed in a separate Order.

II. EXECUTIVE SUMMARY

3. We initiated this proceeding in order to explore ways to promote more effective and efficient use of PLMR spectrum. Although the immediate problem we sought to address was frequency congestion, our broader objective was to develop a regulatory strategy that promotes more efficient use of the existing spectrum allocations to satisfy future private land mobile telecommunications requirements.

4. Consistent with our objective of increasing the efficiency of the PLMR frequency bands and in response to the petitions for reconsideration we received, this *MO&O* clarifies our decisions in the *R&O*, and where necessary, makes appropriate modifications to the rules. We also address several issues raised by petitioners that would have a major impact on the implementation of the *R&O*. The significant decisions in this *MO&O* are as follows:

- We maintain the adopted channel plan because we conclude that this plan provides the most flexibility for and least hardship to existing users, while still accomplishing our goal of increasing spectrum efficiency. We will, however, permit frequency coordinators to recommend frequencies for any technology with lesser bandwidth, including 5 kHz, provided that interference is not caused to other systems.
- We extend the first transition date for the type acceptance of narrowband equipment from August 1, 1996, to the effective date of the rule amendments of this *MO&O*, and retain the second transition date of January 1, 2005.
- We clarify the rules regarding type acceptance to provide greater flexibility for manufacturers to support existing equipment and, where appropriate, to provide alternatives to our efficiency standards.
- We clarify a variety of technical rules including, but not limited to, those pertaining to new power/antenna height limits, the emission mask, and frequency stability requirements.

III. DISCUSSION

A. Channel Plan

5. The Commission set forth a channel plan which allows the spectrum to be "cultivated" by new, more efficient narrowband (NB) technologies.⁶ The Commission adopted a channel plan in the *R&O* based on 7.5 kHz channel spacing in the 150-174 MHz VHF band and 6.25 kHz channel spacing in the 421-430 MHz, 450-470 MHz, and 470-512 MHz UHF bands.⁷ Flexibility is provided to licensees by permitting them to aggregate up to four narrowband channels to employ spectrum efficient wideband technology.⁸ Additionally, licensees are provided with a simple migration path because they will be able to remain on their currently assigned center frequencies⁹ and can continue to use existing equipment while they upgrade to new equipment.¹⁰

6. *Petitions.* Securicor Radiocoms Limited and Linear Modulation Technology Limited (Securicor), Midland International Corporation (Midland), E.F. Johnson Company (E.F. Johnson), and Nippon Telegraph and Telephone Company (NTT) request reconsideration of the new channel plan.¹¹ They request that we adopt a channel plan based on 5 kHz channel spacing. Both Securicor and E.F. Johnson state that the Commission's decision to space channels at 7.5 kHz creates inefficient "white spaces" in the VHF band.¹² Additionally, they assert that the ability to use wideband equivalent technologies by aggregating narrowband channels is not taken into account in our rationale for rejecting 5 kHz spacing.¹³ Securicor, a manufacturer of 5 kHz equipment, states that 5 kHz channel spacing would provide a smooth transition to advanced

⁶ Narrowband or NB refers to channel spacing of 7.5 kHz in the VHF PLMR band and 6.25 kHz in the UHF PLMR bands, or channel bandwidths of 6.25 kHz or less in all PLMR bands unless specified otherwise. NB technology or NB equipment includes all advanced technologies designed to operate with channel bandwidths of 6.25 kHz or less or equipment with 6.25 kHz equivalent efficiency such as time division multiple access (TDMA) (2 channels in 12.5 kHz or 4 channels in 25 kHz).

⁷ See *R&O* at para. 24.

⁸ See *id.* at paras. 24 and 26.

⁹ A center frequency is the frequency at the center of the frequency band assigned to a station. See *R&O* at Appendix A, Figures 3 - 6.

¹⁰ See *R&O* at paras. 24 - 29.

¹¹ Securicor Petition for Reconsideration at 9; Midland Petition for Reconsideration at 2; E.F. Johnson Petition for Reconsideration at 2; NTT Comments on Petition for Reconsideration at 5.

¹² E.F. Johnson Petition for Reconsideration at 3; Securicor Petition for Reconsideration at 11. "White spaces" are portions of spectrum that remain unoccupied.

¹³ E.F. Johnson Petition for Reconsideration at 4; Securicor Petition for Reconsideration at 15-17.

technologies by allowing existing users to remain on their current channel centers and accommodating a layering of many different technologies.¹⁴ Securicor further contends that the adopted band plans are not technology-neutral because they do not allow licensees to realize the most critical competitive advantage associated with use of narrowband technologies -- namely, spectrum efficiency.¹⁵ Additionally, Securicor submitted an economic analysis which concludes that a 5 kHz channel plan would generate greater economic benefits than the adopted channel plan because it creates more channels.¹⁶

7. The Association of Public-Safety Communications Officials-International, Inc. (APCO), in opposition to a 5 kHz channel spacing plan, states that the Commission's plan permits private radio users to phase in new technology while retaining critical forward and backward interoperability.¹⁷ Additionally, APCO asserts that requiring 5 kHz channel spacing "... would undermine years of ongoing work by the public safety community to develop interoperability and greater spectrum efficiency at the same time."¹⁸ UTC, The Telecommunications Association (UTC), contends that no new substantive arguments have been raised that should persuade the Commission to reconsider the adopted plan. UTC adds that the adopted channel plan will not preclude the widespread use of 5 kHz.

8. *Discussion.* We have considered these petitions and conclude that the adopted channel plan, based on 7.5 and 6.25 kHz channel spacing, provides the best solution to this complex issue. A prime consideration in our decision was an overwhelming desire among current PLMR users to have flexibility when choosing a migration path to emerging narrowband technology.¹⁹ Users stated that critical components of any new channel plan are the ability to stay on currently assigned center frequencies and the option of implementing a two-step transition through 12.5 kHz equipment.²⁰ Proponents of a 5 kHz plan argue that because we are allowing narrowband channels to be aggregated, these goals can be attained just as easily with 5 kHz channel spacing. We disagree. In a 5 kHz channel plan, a user would need to identify three contiguous channels to obtain a 12.5 kHz channel, but only two are required in a 7.5/6.25 kHz plan. As users migrate to narrower channels and these bands become characterized by a mix of different bandwidth equipment, we believe it will become increasingly difficult to identify

¹⁴ Securicor Petition for Reconsideration at 18.

¹⁵ Securicor Petition for Reconsideration at 14.

¹⁶ Appendix to Securicor Petition for Reconsideration.

¹⁷ In this proceeding, we define "interoperability" as the ability for equipment designed to operate on narrowband channels, 12.5 kHz channels, or 25 kHz channels to communicate with each other.

¹⁸ APCO Opposition and Comments to Petitions for Reconsideration at 3.

¹⁹ See *R&O* at paras. 20-22.

²⁰ See *id.* at paras. 18 and 20.

suitable contiguous channels. Thus, the 7.5/6.25 kHz plan eases the transition for current users, such as businesses and public safety organizations, who desire to implement a two-step transition to narrowband through 12.5 kHz equipment.

9. Petitioners also assert that inefficient white spaces are created by our adopted channel plan, since 12.5 kHz VHF equipment would actually use 15 kHz of spectrum by aggregating two 7.5 kHz VHF channels. However, to use 12.5 kHz equipment in a plan based on 5 kHz channels would also require licensees to use 15 kHz of spectrum because they would have to aggregate three 5 kHz channels. In the UHF band, 12.5 kHz equipment also would use 15 kHz of spectrum in a 5 kHz channel plan, but only 12.5 kHz of spectrum in the adopted plan. Furthermore, a 5 kHz channel plan would require users who choose to implement 6.25 kHz equipment to acquire the same 15 kHz of spectrum needed for 12.5 kHz equipment.²¹ Thus, a 5 kHz channel plan would create as much or more white space than the channel plan we adopted.

10. Finally, with respect to the economic analysis submitted by Securicor, we do not dispute the general contention that smaller channels will lead to more potential users. However, we find that Securicor has not provided a comprehensive analysis because it only looks at the benefits of transitioning to narrower equipment and fails to address the associated costs, such as the cost and availability of radios. We believe that once such costs are taken into account, the channel plan we adopted is the more well-reasoned approach because it accommodates a variety of technologies. Thus, users are provided more choices to implement new systems within their own technical and budgetary constraints.²²

11. Consequently, we conclude that our adopted 7.5/6.25 kHz channel plan is more flexible than a 5 kHz plan because it will accommodate users of 25, 12.5, 6.25, and 5 kHz equipment while accomplishing our goal of increasing spectrum efficiency. Further, this channel plan creates a flexible migration path, which is considered a critical factor by current users. For these reasons, we decline to modify the channel plan as adopted in the *R&O*. However, we are mindful of the fact that some users may want to implement 5 kHz technology within their existing 25 kHz bandwidth. For example, a licensee could fit five 5 kHz channels within its existing 25 kHz bandwidth. Such a channelization, however, would require the licensee to deviate from the adopted band plan. Therefore, we will permit frequency coordinators to recommend frequencies inconsistent with the adopted band plan, for any technology, including 5 kHz, provided that such a system will not cause harmful interference to any existing system.

²¹ Equipment designed to operate with a 6.25 kHz bandwidth overlaid on a 5 kHz channel would use its own channel plus 0.625 kHz of each adjacent channel. Therefore, a user would need to aggregate three 5 kHz channels.

²² See *R&O* at para. 37. The *R&O* detailed the advantages and disadvantages of several channel plans including 2.5 kHz, 5 kHz, a combination of 5 kHz and 6.25 kHz, a combination of 7.5 kHz and 6.25 kHz, 12.5 kHz, and the existing 25 kHz. After consideration of each of these plans, we adopted the channel plan based on 7.5 kHz channel spacing in the VHF band and 6.25 kHz channel spacing in the UHF bands.

B. Transition Period

12. In the *R&O*, we decided to manage the transition to narrowband channels through the type acceptance process.²³ This decision requires that new equipment type accepted after August 1, 1996, and January 1, 2005, meet specified efficiency guidelines.²⁴ We note, however, that this approach does not impose a strict transition timetable upon individual users. Instead, our decision allows users to choose a transition schedule that best fulfills their technical and financial needs while ensuring that new narrowband equipment will be available. We believe that this decision achieves an appropriate balance between the economic and operational impact of transition on existing users and the need for relief from congested radio spectrum.²⁵

(1) Timetable

13. *Petitions.* Kenwood Communications Corporation, Uniden America Corporation, and Maxon America, Inc. (Joint Petitioners) argue that the conversion timetable for the type acceptance of narrowband equipment is too short and fails to account for normal product development cycles.²⁶ They state that "[t]he most aggressive track suggested in the *Notice* in this proceeding ... would have provided a two-year period of conversion ...".²⁷ Additionally, they argue that the transition date for conversion to 6.25 kHz equipment should be extended because "... there is not an established or proven narrowband technology readily available ...".²⁸ To remedy this situation, the Joint Petitioners request that the first transition date be extended to August 1, 1998, and that the second transition date be extended to January 1, 2014.²⁹ Additionally, License Communication Services, Inc. (LCS) requests that the Commission not make any rule changes to Part 90 regarding technical requirements until assurance that all required equipment has been developed and thoroughly tested.³⁰

14. NTT and Securicor oppose the Joint Petitioners' arguments. NTT states that the position of the Joint Petitioners "... reflects a fundamental misunderstanding of the *R&O*, which does not mandate the production or use of any particular type of technology according to a fixed

²³ See *id.* at para. 36.

²⁴ See para. 19, *infra.* for a description of the efficiency standards.

²⁵ See *R&O* at paras. 35 - 40.

²⁶ Joint Petitioners Petition for Reconsideration at 2.

²⁷ Joint Petitioners Petition for Reconsideration at 19-20.

²⁸ Joint Petitioners Petition for Reconsideration at 13-14.

²⁹ Joint Petitioners Petition for Reconsideration at 21.

³⁰ LCS Petition for Reconsideration at 2.

timetable."³¹ Regarding narrowband technology, Securicor states that the current state-of-the-art is defined by 5 kHz systems operating in the 220-222 MHz band. Securicor contends that "[t]he suggestion of the Joint Petitioners that very narrowband systems are unproven simply ignores reality to the detriment of the public interest."³²

15. *Discussion.* We disagree with the Joint Petitioners. As noted by NTT, the transition dates established in the *R&O* do not require manufacturers to take any specific action. While our transition plan sets standards that manufacturers must meet in order to type accept new equipment, each manufacturer decides when it will actually introduce new narrowband equipment. Consequently, we believe it is unnecessary to make extensive changes to the adopted transition dates and, thus, deny the Joint Petitioners' request to do so. Additionally, we note that a number of manufacturers have already type accepted equipment that is compliant with the new rules.³³ However, in consideration of the time elapsed between the *R&O* and adoption of this *MO&O*, and because this *MO&O* modifies rules which affect the type acceptance of equipment, we are extending the first transition date from August 1, 1996, to the effective date of the rule amendments of this *MO&O*. Further, because users are not required to replace existing systems, we find no reason to require equipment that meets the new type acceptance standards to be in place prior to the effective date of the rules. Therefore, we deny LCS's request. However, to remove the uncertainty in trying to anticipate the amount of time necessary to attain a type acceptance grant,³⁴ we are amending Section 90.203 of our rules to clarify that the transition dates refer to type acceptance application filing deadlines, rather than type acceptance grants.

(2) Public Safety Users

16. *Petitions.* APCO asks that we reconsider our decision not to adopt specific deadlines for public safety users to transition from the current 25/30 kHz channels.³⁵ It states that the measures being considered in the *FNPRM* do not provide sufficient incentives for public safety users to expeditiously transition to narrower equipment because the objectives, concerns, and economic status of public safety users are quite different from other private spectrum users.³⁶

³¹ NTT Comments on Petitions for Reconsideration at 3.

³² Securicor Comments on Petitions for Reconsideration at 5.

³³ As of December 10, 1996, the following manufacturers have type accepted equipment which complies with the new rules: Kenwood, Motorola, Ericsson, Tait, Yaesu, E.F. Johnson, Maxon, Daniels, Philips, Standard, Midland, Scope, Icom, Hexagon, Pyramid, RELM, Transcript, and Hohe El.

³⁴ Due to factors such as the complexity and completeness of applications for type acceptance, the amount of time between when an application is filed and when type acceptance is actually granted can not reliably be predicted.

³⁵ APCO Petition for Reconsideration at 3.

³⁶ The *FNPRM* seeks to explore issues regarding exclusivity with the right to lease excess capacity, the implementation of a user fee system, and the use of competitive bidding.

In order to relieve congestion in public safety spectrum allocations, APCO requests that we implement the following schedule for public safety users:³⁷

January 1, 1997 - All new systems must operate at no more than 12.5 kHz bandwidth to attain primary status.

January 1, 2005 - All urban systems must operate at no more than 12.5 kHz bandwidth to retain primary status.

17. APCO further believes that rather than identifying, at this time, a specific date for transition to 6.25 kHz equipment, the Commission should monitor developments in the marketplace and revisit the issue at a later date.³⁸ NTT is opposed to APCO's abandonment of a transition to 6.25 kHz channels, stating that if the Commission fails to impose narrowband technology requirements on public safety users, the objectives and goals of the *R&O* could be severely compromised.³⁹

18. *Discussion.* We decline to adopt the transition schedule for public safety users as recommended by APCO. The imposition of a mandate on any user, particularly public safety entities, to replace existing equipment and systems, is contrary to one of our basic goals in this proceeding of providing maximum flexibility to individual users. Also, since public safety entities are funded by local tax dollars, and are often constrained by limited financial resources, subjecting these entities to such a mandate could be unduly burdensome. Further, in light of the work of the Public Safety Wireless Advisory Committee and the Commission's overall evaluation and assessment of public safety wireless communications in WT Docket No. 96-86, it would be premature at this time to make decisions regarding transition dates for public safety users.⁴⁰ Finally, because we are not adopting a transition schedule for public safety users, we will not address the merits of APCO's request to only transition to 12.5 kHz channels.

³⁷ APCO Petition for Reconsideration at 5.

³⁸ APCO Petition for Reconsideration at 6.

³⁹ NTT Comments on Petitions for Reconsideration at 5.

⁴⁰ The Commission is addressing present deficiencies as well as the future communications needs of public safety agencies in WT Docket No. 96-86. See *The Development of Operational, Technical, and Spectrum Requirements for Meeting Federal, State and Local Public Safety; Agency Communication Requirements Through the Year 2010*, WT Docket No. 96-86, *Notice of Proposed Rule Making*, 11 FCC Rcd 12460 (1996) (*Public Safety Notice*).

C. Spectrum Efficiency Standards

19. In the *R&O*, we adopted spectrum efficiency standards for newly type accepted equipment at each transition date.⁴¹ Specifically, we require at least one voice channel per 12.5 kHz of channel bandwidth for equipment type accepted after August 1, 1996, and at least one voice channel per 6.25 kHz of channel bandwidth for equipment type accepted after January 1, 2005. Additionally, after August 1, 1996, equipment designed for data operation must be capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of bandwidth.⁴²

(1) Alternative Showings

20. *Petitions.* Advanced Meter Reading Technologies (AMRT), Schlumberger Meter Communication Systems (Schlumberger), and UTC request that the type acceptance rules be amended to allow alternative showings of spectrum efficiency for low power frequency reuse systems.⁴³ AMRT contends that multiple low-power, low-speed transmitters can serve more homes than a single high-power, high-speed transmitter and with less impact to adjacent channel operations. It suggests a formula to compute a minimum data rate for these systems based on antenna height, channel bandwidth, and a frequency reuse ratio.⁴⁴ Finally, Metroplex asks the Commission to consider the efficiencies that can be obtained using bit rates slower than specified in the efficiency standard. Metroplex contends that the efficiency standard is arbitrary and that the effective information throughput using the efficiency standard may be lower than can be accomplished with a more efficient non multi-level modulation technique.⁴⁵ No oppositions were filed in response to any of these requests.

21. *Discussion.* Our adopted approach has the benefit of being easy to measure and therefore simple to enforce. While AMRT's approach has the benefit of tailoring the minimum bit rate to individual system parameters, it would place unreasonable burdens upon manufacturers as well as the Commission because of the requirement to type accept many radios, each

⁴¹ See *R&O* at para. 97.

⁴² See para. 15, *supra*. for a discussion regarding the transition dates.

⁴³ AMRT Petition for Reconsideration at 4; Schlumberger Petition for Reconsideration at 5; UTC Comments on Petitions for Reconsideration at 8.

⁴⁴ AMRT Petition for Reconsideration at 5.

⁴⁵ Letter from Metroplex Mobile Data, Inc. to William F. Caton, Acting Secretary, Federal Communications Commission (FCC), dated September 12, 1995.

corresponding to a particular combination of parameters.⁴⁶ In contrast, under our adopted approach, manufacturers could type accept one radio which meets the minimum efficiency standard for all conditions. It is evident from the petitions, and the comments to the *Refarming Notice*,⁴⁷ that developing a spectral efficiency standard to cover all contingencies is extremely difficult. Nevertheless, we agree with AMRT and Schlumberger that there is a place within the PLMR environment for spectrum efficient low-power, frequency reuse systems.⁴⁸ Therefore, rather than setting a spectral efficiency standard for these radios, we will instead exempt all transmitters that operate with less than 500 mW output power from the bit rate requirement for type acceptance.

22. Regarding Metroplex's request, we will not alter the efficiency standard. We recognize, however, that this standard addresses only one facet of the spectral efficiency of a system.⁴⁹ Therefore, we will provide manufacturers with additional flexibility to design spectrally efficient transmitters. The Commission's Equipment Authorization Division may, on a case by case basis, grant type acceptance to equipment with slower bit rates than specified in Sections 90.203(j)(3) and 90.203(j)(5) of our rules, provided that an acceptable technical analysis is submitted with the application which demonstrates that the slower data rate will provide more spectral efficiency than the standard data rate.

(2) Clarifications and Explanations

23. We agree with and are incorporating certain clarifications recommended by SEA into our rules.⁵⁰ First, in order to be consistent with terminology used in Sections 90.203 and 90.210 of our rules, we have changed the term "overall bandwidth" to "channel bandwidth" in Sections 90.203(j)(3) and 90.203(j)(5). Second, in order to prevent manufacturers from circumventing the voice channel requirement we have inserted the word "additionally" prior to

⁴⁶ For example, using AMRT's formula a 2 Watt transmitter used in a 2.2 km cell with a frequency reuse ratio of 1.86 and an antenna height of 6 m would need to meet a minimum data rate of 10,325 bps per 25 kHz while that same 2 Watt transmitter with a 15 m antenna height would result in a 3 km cell and a frequency reuse ratio of 1.0 and would need to meet a minimum data rate of 19,200 bps per 25 kHz. Therefore, the options would be to type accept only a radio capable of meeting the higher standard of 19,200 bps per 25 kHz or type accepting a separate radio for every combination of transmitter power and antenna height. See AMRT Petition for Reconsideration at 6.

⁴⁷ See *R&O* at para 96.

⁴⁸ Similar to the situation encountered in cellular radio, such systems attain spectral efficiency through frequency reuse. Using the spectral efficiency metric, quantity/Hertz/meter²/time, it is seen that spectral efficiency increases as cell size decreases which in turn allows power to be decreased, thereby increasing frequency reuse.

⁴⁹ Many factors other than overall bit rate affect the spectral efficiency of a system. For example, Ericsson stated that the most appropriate measure of spectrum efficiency is quantity of communications achieved per unit of occupied spectrum as a function of the geographic area occupied by the signal and the time required to achieve the communications. (See *R&O* at para. 96; See Ericsson's Comments to the *Refarming Notice* at 15.)

⁵⁰ SEA Petition for Reconsideration at 11.

the last sentence in Sections 90.203(j)(3) and 90.203(j)(5). This will clarify the referenced rule sections to ensure that radios type accepted for both voice and data meet the efficiency standards by precluding claims that digital voice is actually data. For example, after August 1, 1996,⁵¹ a radio that meets the data rate standard, such as a 25 kHz, 19,200 bits per second (bps) digital radio, must provide at least two voice channels to be type accepted for telephony.⁵² Likewise, after January 1, 2005, a 12.5 kHz, 9,600 bps or a 25 kHz, 19,200 bps digital radio must provide at least two or four voice channels, respectively, to be type accepted for telephony.

24. To clarify further the distinction between digital voice and data, we refer to the definitions in Part 2 of the rules.⁵³ In general, radios that operate under Part 90 are type accepted for telephony, telegraphy,⁵⁴ telemetry,⁵⁵ or telecommand.⁵⁶ We agree with Motorola, Inc. (Motorola) that radios type accepted for telephony must meet the voice channel standard, and those type accepted for telegraphy or telemetry must meet the data rate standard.⁵⁷ We further agree that radios that are type accepted for both telephony and telegraphy or telemetry must meet both standards. Additionally, because Section 90.207(b) of our rules allows stations authorized for telephony to use emissions for telecommand, the telecommand function of such radios will not be subject to the data rate standard.

25. Also, Motorola contends that data transmitted through an external microphone port should not be subject to the data rate standard since such transmissions are limited by an audio filter.⁵⁸ Dataradio, in opposition to this view, contends that the benefits of refarming will be considerably less than expected if users are able to circumvent the data rate rules by attaching

⁵¹ See para. 15, *supra*. for a discussion regarding a change to this transition date.

⁵² Telephony is a form of telecommunications set up for the transmission of speech or, in some cases, other sounds.

⁵³ See 47 C.F.R. § 2.1.

⁵⁴ Telegraphy is a form of telecommunication which is concerned in any process providing transmission and reproduction at a distance of documentary matter, such as written or printed matter or fixed images, or the reproduction at a distance of any kind of information in such a form. Facsimile use is included in the definition of telegraphy.

⁵⁵ Telemetry is the use of telecommunication for automatic indicating or recording measurements at a distance from the measuring instrument.

⁵⁶ Telecommand is the use of telecommunication for the transmission of signals to initiate, modify, or terminate functions of equipment at a distance.

⁵⁷ See Ex parte presentation of Motorola on December 12, 1995; Letter to William F. Caton, Acting Secretary, Federal Communications Commission, dated January 25, 1996.

⁵⁸ See Ex parte presentation of Motorola on December 12, 1995; Letter to William F. Caton, Acting Secretary, Federal Communications Commission, dated January 25, 1996.

slow speed modems to the microphone connections of analog radios.⁵⁹ Because transmissions made via modem through the external microphone port of an analog radio are limited to audio, the data rate standard will not be applied to such uses. We believe that such use will not undermine the benefits of refarming. These analog radios transmit data essentially on an ancillary basis. Thus, the ever increasing demand by users for data capacity would not be met by this method.

26. Finally, on our own motion, we clarify the rules regarding paging systems. In the *R&O*, we did not impose narrowband requirements on any of the paging-only channels in the PLMR bands.⁶⁰ Implied, but not stated explicitly, in Section 90.203(j)(7) of our rules is an exemption from the spectrum efficiency requirements imposed by the *R&O*. We are modifying our rules to state explicitly this exemption.

D. Power/Antenna Height Limits

27. In the *R&O*, we adopted new power and antenna height limitations based on the "safe harbor" tables submitted by the Land Mobile Communications Council (LMCC) in its comments to the *Refarming Notice*.⁶¹ These new limits, as set forth in Section 90.205 of our rules, allow various combinations of effective radiated power (ERP) and antenna height above average terrain (HAAT) based upon the size of an applicant's desired service area and the applicant's operating frequency.⁶² In general, the rules allow for a maximum ERP of 500 watts and maximum service area radii of 40 km in the VHF band and 32 km in the UHF band. The rules state that larger areas, up to 80 km, will be authorized provided that the applicant demonstrates that the requested station parameters will not produce coverage in excess of that which is required.⁶³ However, areas larger than 80 km will be authorized on a secondary basis. Finally, these new rules only apply to new stations, which were defined as stations not functionally integrated with an earlier-installed system.⁶⁴

⁵⁹ See *Ex parte* presentation of Dataradio on January 23, 1996.

⁶⁰ See *R&O* at footnote 116.

⁶¹ See *id.* at para. 69; Comments of LMCC to *Refarming Notice* at 17.

⁶² "Average terrain" is defined as the average elevation of the terrain between 3.2 and 16 km (2 and 10 miles) from the antenna site. HAAT is defined as the height of the center of the radiating element of the antenna above the average terrain. See 47 C.F.R. § 90.309(a)(4) (provides the HAAT calculation method).

⁶³ See 47 C.F.R. §§ 90.205(d)(1) and 90.205(g)(1).

⁶⁴ See *R&O* at paras. 69 - 73.

(1) **Power/Antenna Height Tables**

28. *Petitions.* APCO, Automobile Association of America (AAA), Alarm Industry Communications Committee (AICC), Personal Communications Industry Association (PCIA), and UTC assert that the power/antenna height tables are based on the assumption of average terrain conditions and may not be accurate as they do not account for extreme terrain.⁶⁵ In this connection, they argue that special separation criteria should be developed for systems that operate in the 150-174 MHz and 421-512 MHz bands under conditions of extreme terrain.⁶⁶ Such consideration would be similar to the special separation tables developed to prevent harmful interference between co-channel users who operate in extreme terrain in the 800 MHz band.⁶⁷ Further, they, as well as LMCC, advocate that a streamlined process for deviating from the power/antenna height tables be considered for applicants that operate in areas of non-uniform terrain.⁶⁸ Additionally, they request that applicants be permitted to use any commonly accepted propagation model to demonstrate radio system coverage, as long as the model is properly identified and the applicant explains why the model will provide more accurate results than the power/antenna height tables.⁶⁹ Finally, to avoid needless expense and delay, and because requests for service areas greater than 40 km in the VHF band and 32 km in the UHF band will be reviewed by the frequency coordinators, the petitioners ask that a formal waiver not be required for such requests.⁷⁰

29. In addition, LMCC seeks clarification regarding whether applicants may operate at power levels in excess of the reference ERP in the tables set forth in Sections 90.205(d) and 90.205(g) of our rules if the antenna height above average terrain is reduced.⁷¹ LMCC also requests clarification on whether the Commission will permit systems to be licensed for ERPs in excess of 500 watts.⁷² LMCC points out that while the *R&O* states that the maximum allowable ERP is 500 watts, Sections 90.205(d)(2) and 90.205(g)(2) of our rules permit the frequency

⁶⁵ APCO Petition for Reconsideration at 7, AICC Petition for Reconsideration at 6, AAA Petition for Reconsideration at 2-3, PCIA Petition for Reconsideration at 4, and UTC Comments on Petition for Reconsideration at 6-7.

⁶⁶ See, e.g., AICC Petition for Reconsideration at 6 and AAA Petition for Reconsideration at 2-3.

⁶⁷ See 47 C.F.R. § 90.621.

⁶⁸ See, e.g., LMCC Petition for Reconsideration at 8 and APCO Petition for Reconsideration at 7.

⁶⁹ See, e.g., AAA Petition for Reconsideration at 2-3, AICC Petition for Reconsideration at 6, and UTC Comments to Petitions for Reconsideration at 7.

⁷⁰ See, e.g., PCIA Petition for Reconsideration at 4 and APCO Petition for Reconsideration at 7.

⁷¹ LMCC Petition for Reconsideration at 8.

⁷² LMCC Petition for Reconsideration at 9.

coordinators to recommend ERP levels in excess of those specified in the safe harbor tables.⁷³ Finally, LCS contends that the power reduction rules do not take into account changing weather and atmospheric conditions which can cause variable path fading.⁷⁴

30. *Discussion.* We agree that special consideration should be given to the power/antenna heights in areas of extreme terrain. We recognize that in these areas, average terrain calculations may not provide accurate depictions of the actual terrain over which a system will operate and therefore our tables may not provide an appropriate antenna height/power combination for a desired service area size. Although Sections 90.205(d)(2) and 90.205(g)(2) of our rules provide a method by which applicants can deviate from the tables,⁷⁵ they do not clearly indicate that this option is applicable to systems operating in areas of extreme terrain. In this connection, we modify Sections 90.205(d)(2) and 90.205(g)(2) to reflect this policy. Additionally, Sections 90.205(d)(2) and 90.205(g)(2) allow the use of generally accepted engineering practices and standards, including models that are widely accepted by the engineering community, as producing outputs representative of real world results. However, we will not routinely accept analyses based on these propagation models. We believe that this option should be available only in isolated instances where applicants need to deviate from the tables due to special circumstances.

31. Applicants who demonstrate special circumstances (*e.g.*, extreme terrain conditions or need for a larger service area) will not be required to submit a waiver request to the Commission. Rather, the required engineering analysis should be submitted to the frequency coordinator and as an attachment to the license application, FCC Form 600. Additionally, a waiver request will be unnecessary for applicants who request service areas greater than 40 km in the VHF band and 32 km in the UHF band. These applications, however, pursuant to footnote 4 in Tables 1 and 2 of Section 90.205 of our rules, must be accompanied by a justification for the larger service area and include a technical analysis demonstrating that the signal strength at the edge of the service area is within the specified guidelines. We will rely heavily on the recommendations of the frequency coordinators in considering such requests.

32. Regarding the maximum allowable ERP and antenna height, we will allow applicants to exceed the reference antenna height limits if they correspondingly lower their power. In these cases, applicants must demonstrate that their signal strength at the edge of the service area is within the specified guidelines. This approach is consistent with the requirements we have

⁷³ LMCC Petition for Reconsideration at 9.

⁷⁴ LCS Petition for Reconsideration at 5.

⁷⁵ Our current rules permit an applicant who requests a higher ERP than permitted in the tables to submit to the frequency coordinator a technical analysis, based upon generally accepted engineering practices and standards, that demonstrates that the requested station parameters will not produce a signal strength in excess of 37 dBu in the VHF band or 39 dBu in the UHF band at any point along the edge of the requested service area. *See* 47 C.F.R. §§ 90.205(d)(2) and 90.205(g)(2).

adopted for systems operating above 800 MHz.⁷⁶ However, we affirm that the maximum allowable ERP is 500 watts as specified in footnote 2 of the tables provided in Sections 90.205(d) and 90.205(g) of our rules. This power limitation is intended to reduce the incidence of over-powered stations and promote frequency reuse.⁷⁷

33. UTC requests clarification that the load shedding frequency, 154.46375 MHz, is not subject to the power/antenna height tables of Section 90.205 of our rules.⁷⁸ We note that the tables in Section 90.205 only apply in instances when a power level is not otherwise specifically provided in the rules.⁷⁹ Thus, pursuant to Section 90.63(d)(6) of our rules, operations on the load shedding frequency may continue to be authorized with up to 300 watts output power.⁸⁰

34. We are not persuaded by LCS's argument that changes in the power/antenna height tables are necessary to account for changing weather and atmospheric conditions. As an initial matter, we note that the power/antenna height tables adopted in the R&O only apply to new stations. Thus, contrary to LCS's contentions,⁸¹ the operation of existing stations will not be affected by our adoption of these power/antenna height restrictions. We further note that the tables are based on F(50,50) curves which estimate the field strength exceeded at 50 percent of the potential receiver locations for at least 50 percent of the time. These parameters are sufficient for most systems to provide adequate signal levels to most receiver locations. Additionally, weather effects, such as those due to water vapor, are negligible below microwave frequencies. We recognize, however, that vegetation effects, such as those associated with forests, are very real below microwave frequencies and may dictate more power. When conditions dictate that a station require more power than the tables allow, remedies already exist under our rules, as discussed above.

(2) Classification of Base Stations

35. *Petitions.* UTC and LMCC seek clarification of the rules that would classify all base stations with service areas greater than 80 km as secondary.⁸² Both petitioners note that certain geographic areas, particularly in western regions, warrant special consideration because the terrain in those areas provide few suitable transmitter sites. UTC further adds that, "[i]t

⁷⁶ See 47 C.F.R. § 90.635.

⁷⁷ See R&O at para. 73.

⁷⁸ UTC Petition for Reconsideration at 6.

⁷⁹ See 47 C.F.R. § 90.205.

⁸⁰ See 47 C.F.R. § 90.63(d)(6).

⁸¹ LCS Petition for Reconsideration at 5.

⁸² UTC Petition for Reconsideration at 5; LMCC Petition for Reconsideration at 8-9.

would ill-serve the public interest if, for example, a public service utility were forced to accept secondary status for its PLMR base station facilities simply because the utility optimized the use of available transmitter sites ...". UTC suggests changing Sections 90.205(d)(3) and 90.205(g)(3) of our rules to confer primary status on stations where there is a demonstration that a greater service area is needed and that the use of additional transmitter sites is not practicable.⁸³

36. *Discussion.* We find merit in UTC's argument, and believe that some clarification of our rules is necessary. We note that licensees who need to communicate over large distances generally employ systems that make extensive use of mobile relay stations,⁸⁴ which are afforded the protection of primary status under our rules. Thus, because mobile relay stations would typically be within 80 km of another base station, primary status would be conferred on the entire area that a licensee needs to cover. We believe that coverage areas up to 80 km around a single base station will serve the vast majority of licensees. Further, we do not believe it unreasonable to expect that suitable base station sites can be found within 80 km of another base station. Therefore, we will modify Sections 90.205(d)(3) and 90.205(g)(3) of our rules to confer primary status for communications within 80 km from a base station. We also recognize that some licensees' operations may require primary status within a region larger than 80 km. Because we anticipate that a limited number of licensees will have such needs, we will entertain waiver requests for those instances where a licensee requests coverage by one base station for an area greater than 80 km. If the licensee makes a sufficient showing, including but not limited to the ability to provide coverage with the proposed facilities, we will grant the waiver request and make that base station primary over the entire coverage area.

(3) New Stations

37. *Petitions.* Many petitioners, including AICC, LMCC, Page Hawaii, Inc. (Page Hawaii), AzCOM Paging, Inc. (AzCOM), AAA, and UTC, seek clarification on what constitutes a new station.⁸⁵ AICC states that our definition is ambiguous and, based on its plain language, permits existing licensees to modify and expand their systems without being subject to the new power/antenna height rules.⁸⁶ LMCC contends that "new stations" should not include existing stations that modify their authorizations to change parameters such as location, frequency, or

⁸³ UTC Petition for Reconsideration at 6.

⁸⁴ A "mobile relay station" is a base station in the mobile service authorized to retransmit automatically on a mobile service frequency, communications which originate on the transmitting frequency of the mobile station. See 47 C.F.R. § 90.7.

⁸⁵ AICC Petition for Reconsideration at 5-6; LMCC Petition for Reconsideration at 10; Page Hawaii Petition for Reconsideration at 6; AzCOM Petition for Reconsideration at 5-6; AAA Petition for Reconsideration at 4; UTC Comments on Petitions for Reconsideration at 8.

⁸⁶ AICC Petition for Reconsideration at 5-6.

emissions.⁸⁷ Further, AAA urges the Commission to treat currently operating facilities that are being converted for use on narrower channels as existing stations. In this connection, AAA argues that existing licensees who elect to use more spectrally efficient equipment should not have to add stations in order to maintain their current coverage.⁸⁸

38. Page Hawaii and AzCOM request that additional transmitters and relocations not be considered "new stations."⁸⁹ They request that the Commission allow full power operation, as defined under the previous rules, if applicants indicate that proposed sites expand an existing operation. In addition, AAA and LMCC ask the Commission to confirm that grandfathering rights will be extended to stations whose ownership changes through transfer or assignment.⁹⁰ Finally, LMCC and UTC request that the term "new stations" not include base stations and mobile relay stations that are added to an existing system even if they are authorized to operate on different frequencies.⁹¹

39. *Discussion.* As a general matter, we elected to exempt existing stations from complying with the power/antenna height tables adopted in the *R&O* in order to afford licensees flexibility to modify, expand, or upgrade their facilities without adversely affecting their current operations. Section 90.135 of our rules provides examples of permissible modifications to authorized stations. Stations that modify their existing authorization in accordance with one of the listed modifications will not be subject to the new power/antenna height rules. Thus, modifications to frequency, emissions, power, antenna height, location and number of transmitters, class of station, ownership, control, or corporate structure will be permitted.⁹² We decline to grant the request of UTC and LMCC to characterize the addition of base and mobile relay facilities that operate on different frequencies from an existing system as an existing system. We believe that such an approach would allow a licensee to effectively create a new system by adding new facilities on frequencies not previously authorized and not be subject to the new power/antenna height tables. This result would be contrary to the underlying purpose of our exemption for existing stations.

40. Because Section 90.135(a) of the Commission's rules allows licensees to modify their authorizations due to a change in emissions, the new power/antenna height limits will not apply to systems that are modified by converting to equipment designed for narrower channel

⁸⁷ LMCC Petition for Reconsideration at 10.

⁸⁸ AAA Petition for Reconsideration at 4.

⁸⁹ Page Hawaii Petition for Reconsideration at 6; AzCOM Petition for Reconsideration at 5.

⁹⁰ LMCC Petition for Reconsideration at 10; AAA Petition for Reconsideration at 4.

⁹¹ LMCC Petition for Reconsideration at 10; UTC Comments on Petitions for Reconsideration at 8.

⁹² Approval of modifications is made on a case-by-case basis.

bandwidths. Furthermore, if the only modification that a licensee makes to a system is a narrowing of its emission, a formal application for modification need not be filed with the Commission. However, the licensee will be required to notify the Commission of this change immediately, either by filing FCC Form 405-A or submitting a letter in accordance with Section 90.135(d) of the Commission's rules. We have modified Sections 90.135(a)(2) and 90.135(b) of our rules accordingly.

(4) Paging Channels

41. *Petitions.* Page Hawaii, AzCOM, and PCIA seek reconsideration of the power/antenna height tables as they relate to private carrier paging channels.⁹³ Page Hawaii contends that rules promulgated in the *R&O* did not contain the proposed exception to the antenna height/power limits for operators on certain private carrier paging frequencies.⁹⁴ PCIA states that "[s]ince paging systems are not required to specify area of operation ... it would appear that the safe harbor table does not apply to such systems ..."⁹⁵ Further, PCIA originally suggested that the Commission not change any of the technical rules for the paging channels and allow these systems to operate with up to 350 watts. Finally, Page Hawaii and AzCOM state that the antenna height/power tables are based on the propagation of signal levels necessary for communication with mobiles in average terrain (not within buildings) and are not appropriate to determine signal levels for paging systems.⁹⁶ APCO opposes the request by Page Hawaii and AzCOM to raise the power levels for paging channels and states that "[p]aging systems operating from the same (or nearby) high-level sites as public safety and other land mobile operations often cause desensitizations and intermodulation. Increasing the power of the paging systems would greatly exacerbate the problem."⁹⁷ In response, Page Hawaii and AzCOM acknowledge that a higher potential for interference exists at higher power levels, but assert that it can be controlled through the frequency coordination process.⁹⁸

42. *Discussion.* We find the arguments of the paging companies persuasive. We believe that our rules should reflect the differences between paging systems and the majority of two-way mobile systems in the PLMR bands. In this connection, we will allow new one-way paging operations to operate at the same power levels that applied prior to the adoption of the

⁹³ Page Hawaii Petition for Reconsideration at 2-5; AzCOM Petition for Reconsideration at 2-4; PCIA Petition for Reconsideration at 5.

⁹⁴ Page Hawaii Petition for Reconsideration at 2.

⁹⁵ PCIA Petition for Reconsideration at 5.

⁹⁶ Page Hawaii Petition for Reconsideration at 3; AzCOM Petition for Reconsideration at 2.

⁹⁷ APCO Opposition and Comments to Petitions for Reconsideration at 3-4.

⁹⁸ Page Hawaii Response to APCO Opposition to Petitions for Reconsideration at 2; AzCOM Response to APCO Opposition to Petitions for Reconsideration at 2.

R&O, i.e., for most stations, 350 watts output power with no limit on ERP, on the frequencies specifically reserved for one-way paging.⁹⁹ We have amended our rules to allow this type of operation. Lower power limits will continue to apply in the Special Emergency Radio Service on 157.450 MHz, which is limited to an output power of 30 watts,¹⁰⁰ and in the Business Radio Service on 154.625 MHz and 158.460, which are limited to an output power of 20 watts,¹⁰¹ and 465.000 MHz, which is limited to an output power of 35 watts.¹⁰² Further, in the Business Radio Service, 462.9375 MHz, 464.9875 MHz, and 465.0125 MHz will be available only for low power operations in order to prevent incidences of harmful interference between paging channels and channels on which traditional two-way communications are permitted. Additionally, we note that the Commission is considering changes to the paging rules in a separate proceeding.¹⁰³

E. Type Acceptance Requirements

43. The *R&O* allows manufacturers to continue producing and supporting 25 kHz equipment through upgrades and permissive changes.¹⁰⁴ To this end, Section 90.203(j)(6) of our rules permits permissive changes to transmitters designed to operate on channel bandwidths wider than 12.5 kHz until August 1, 1996,¹⁰⁵ except for transmitters that have the inherent capability for multi-mode or narrowband operation.¹⁰⁶

⁹⁹ The frequencies available for one-way paging are: 150.830 MHz, 150.920 MHz, 151.070 MHz, 151.190 MHz, 151.310 MHz, 152.480 MHz, 154.625 MHz, 157.740 MHz, 158.460 MHz, 462.750 MHz, 462.775 MHz, 462.800 MHz, 462.825 MHz, 462.850 MHz, 462.875 MHz, 462.900 MHz, and 462.925 MHz in the Business Radio Service and 152.0075 MHz, 157.450 MHz, and 163.250 MHz in the Special Emergency Radio Service.

¹⁰⁰ See 47 C.F.R. § 90.53(b)(11).

¹⁰¹ See 47 C.F.R. § 90.75(c)(15).

¹⁰² See 47 C.F.R. § 90.75(c)(30).

¹⁰³ See Revision of Part 22 and Part 90 of the Commission's Rules to Facilitate Future Development of Paging Systems and Implementation of Section 309(j) of the Communications Act -- Competitive Bidding, WT Docket No. 96-18, PP Docket No. 93-253, *Notice of Proposed Rule Making*, 11 FCC Rcd 3108.

¹⁰⁴ See *R&O* at para. 40. In general, permissive changes are those changes which result in equipment which is electrically and mechanically interchangeable and do not change equipment beyond the rated limits established by the manufacturer and accepted by the Commission when type acceptance is granted or which bring the performance of equipment beyond the rated limits as originally filed by the manufacturer but not below the minimum requirements of the applicable rules. See 47 C.F.R. § 2.1001.

¹⁰⁵ See para. 15, *supra*, for a discussion regarding a change to this transition date.

¹⁰⁶ See *R&O* at para. 102.

44. *Petitions.* The Telecommunications Industry Association (TIA), Motorola, APCO, and UTC request that we reconsider our decision.¹⁰⁷ TIA and Motorola argue that it is unnecessary to prohibit manufacturers from making minor design changes to existing 25 kHz equipment because our rules already ensure a transition to more narrowband equipment.¹⁰⁸ Motorola adds that "... it is important to maintain our flexibility to modify and improve these radios in response to customer requirements, from changes in manufacturing technique, as a result of efforts to reduce costs and from the necessity of making changes in components in order to accommodate the availability of parts and subcomponents."¹⁰⁹

45. Securicor, however, opposes this request.¹¹⁰ It asserts that the Commission has provided flexibility to manufacturers by allowing them to continue manufacturing spectrally inefficient equipment as it is currently configured, or allowing upgrades and modifications provided that a multi-mode feature is added. Securicor contends that granting this request is inconsistent with the primary goal in this proceeding since it would excuse "... in perpetuity compliance with the multi-mode requirement."¹¹¹ Finally, Securicor argues that if we grant this request, we should "sunset" or extend any exception to no more than five years from the date of adoption of the *R&O* so that the availability of inefficient wideband equipment will not be facilitated indefinitely.

46. *Discussion.* Our intent is to allow only those modifications which would provide a multi-mode capability or a narrowband mode to existing equipment. In these instances, manufacturers must obtain a new FCC Identifier for their equipment. Modifications which entail the redesign of existing equipment will not be allowed. Our intention, however, is not to prevent manufacturers from supporting their existing equipment. Therefore, we are revising Section 90.203(j)(6) of our rules to clarify that we will continue to allow permissive changes to existing equipment. We recognize that the life of some inefficient wideband equipment may be extended through the use of permissive changes. However, we believe most users, especially those in congested urban areas, will have a strong incentive to transition to narrowband equipment, thus shrinking the market for wideband equipment. Therefore, because the number of permissive changes will decline as a result of market forces, there is no need for specific action by the Commission.

¹⁰⁷ TIA Petition for Reconsideration at 1-2; Motorola Petition for Reconsideration at 3-5; UTC Comments on Petitions for Reconsideration at 9; APCO Opposition and Comments on Petitions for Reconsideration at 4.

¹⁰⁸ TIA Petition for Reconsideration at 1-2; Motorola Petition for Reconsideration at 3-5.

¹⁰⁹ Motorola Petition for Reconsideration at 4.

¹¹⁰ Securicor Comments on Petitions for Reconsideration at 3-4.

¹¹¹ Securicor Petition for Reconsideration at 4.

F. Frequency Stability Limits

47. When compared to wideband channels, *i.e.*, 25 kHz channels, the rules adopted in the *R&O* allow emissions on narrowband channels to occupy a larger percentage of the channel.¹¹² This combination of increased channel occupancy and narrower channel spacing increases the importance of frequency stability to reduce adjacent channel interference. Therefore, the Commission adopted stringent frequency stability requirements as recommended by TIA.¹¹³

48. *Petitions.* SEA contends that the frequency stability limits for mobile radios designed to operate with channel bandwidths of 6.25 kHz are too restrictive.¹¹⁴ It states that in the 421-512 MHz band, the emission masks adopted for 6.25 kHz and 12.5 kHz channels overlap when placed 6.25 kHz apart. Therefore, "[t]ight stability limits ... achieve nothing with regard to adjacent channel protection, since adjacent channels cannot coexist in the same area."¹¹⁵ In the 150-174 MHz band, SEA states that emission mask will allow same-area adjacent channel use, but the frequency stability limits need not be as tight as those adopted. Motorola, in support of SEA, states that the stability requirements can be eased because adjacent channels will be protected through the frequency coordination process. Further, Motorola states that the TIA projections on which the adopted standards are based have "... proven to be overly ambitious ..."¹¹⁶ Securicor recommends a "brickwall" approach at the channel edge, *i.e.*, the Commission should not impose any in-band restrictions, but should instead focus on out-of-band emissions. Securicor contends that this approach would result in greater bandwidth utilization, would be technology neutral, and would sufficiently address problems cited by SEA.¹¹⁷

49. Additionally, SEA requests that the Commission allow mobile radios in the 150-174 MHz and 421-512 MHz bands to use the signal from associated base stations to achieve the specified frequency stability.¹¹⁸ SEA notes that such a provision would be similar to the rules for the 220-222 MHz band.¹¹⁹

¹¹² The authorized bandwidth on a 25 kHz channel is 20 kHz, on a 12.5 kHz channel is 11.25 kHz, and on a 6.25 kHz channel is 6 kHz. See 47 C.F.R. 90.209.

¹¹³ See *R&O* at para. 93.

¹¹⁴ SEA Petition for Reconsideration at 3.

¹¹⁵ SEA Petition for Reconsideration at 6.

¹¹⁶ Ex parte presentation of Motorola on December 12, 1995; Letter from Motorola to William F. Caton, Acting Secretary, FCC, dated January 25, 1996.

¹¹⁷ Securicor Comments on Petitions for Reconsideration at 4-5.

¹¹⁸ SEA Petition for Reconsideration at 7.

¹¹⁹ SEA Petition for Reconsideration at 7.

50. *Discussion.* We find the arguments of SEA and Motorola for easing the frequency stability requirements to be persuasive. We agree that, in the VHF band, a less stringent requirement can be tolerated because of the presence of a small guard band created by our rules which limits emissions on the 7.5 kHz channels to an authorized bandwidth of 6 kHz.¹²⁰ Further, we believe that the frequency coordination process can compensate for less stringent requirements in the UHF band. Therefore, as suggested by SEA, we modify Section 90.213 of our rules to permit mobile radios that operate on narrowband channels to achieve minimum frequency stabilities of 2 parts per million (ppm) in the VHF band and 1 ppm in the UHF band. We also amend Section 90.213 of our rules to correct two minor errors in the frequency stability requirements for the 150-174 MHz, 421-512 MHz, and 800 MHz band allocations.¹²¹ We, however, reject the recommendation of Securicor to adopt a "brickwall" approach at the channel edge. This issue was addressed in the *R&O*¹²² and Securicor has not provided any new substantive information.

51. In the 220-222 MHz band, mobiles may use the signal from the associated base station to attain the specified frequency stability.¹²³ However, in contrast to the Refarming bands, licensees in the 220-222 MHz band have exclusivity and operate with duplex transmissions. Therefore, we believe that the rules pertaining to the 220-222 MHz band are not appropriate for comparison to the refarming bands which have a radio environment characterized by sharing and many simplex systems. Because it is not apparent if these shared simplex channels can support this function, we will not, at this time, permit mobiles to use the signal from the associated base station to attain the specified frequency stability. If, in fact, it can be shown that these channels can support such a function, we will reconsider our decision.

G. Emission Mask

(1) Authorized Bandwidth

52. In order to accommodate our new channel plan, we adopted new guidelines for authorized bandwidth. For equipment designed to operate on 7.5 kHz or 6.25 kHz channels, the

¹²⁰ See 47 C.F.R. 90.209.

¹²¹ In the *R&O*, the frequency stability for wideband, low power equipment operating in the 150-174 MHz band was listed as 5 ppm, rather than 50 ppm, the stability for wideband base stations operating in the 421-512 MHz band was listed as 5 ppm, rather than 2.5 ppm, and Footnote 11 was inadvertently removed from the 800 MHz allocations.

¹²² See *R&O* at para. 89. This approach was rejected in the *R&O* because the emission mask shape would be determined not only by the transmitter's frequency stability but also by the authorized bandwidth of an adjacent channel, which may vary depending on the needs of an adjacent channel user. This would lead to separate type acceptance for each transmitter having different filtering to achieve the necessary mask shape and more complex licensing procedures because determination of an adjacent channel's bandwidth would require adjacent channel coordination.

¹²³ See 47 C.F.R. § 90.213, Footnote 12.

authorized bandwidth is 6 kHz and for equipment designed to operate on 12.5 kHz channels the authorized bandwidth is 11.25 kHz.¹²⁴

53. *Petitions.* SEA requests that the authorized bandwidth for 6.25 kHz channels in the UHF and VHF bands be reduced to 5 kHz.¹²⁵ It states that our emission mask makes the benefit of a 6 kHz authorized bandwidth "... illusory, since same-area operation is simultaneously made impossible."¹²⁶ Further, SEA argues that a 5 kHz authorized bandwidth "... will not jeopardize the successful development of data and digital modulation technologies on narrowband channels."¹²⁷

54. *Discussion.* We decline to reduce the authorized bandwidth from 6 kHz to 5 kHz. The 6 kHz authorized bandwidth was chosen to provide manufacturers with flexibility to implement a wide range of modulation techniques. We note, however, that the emission mask only serves as an upper limit and thus, manufacturers can employ any emission they desire as long as they do not exceed the specified limits. Therefore, if a manufacturer determines that same-area operations cannot be achieved on adjacent narrowband channels, it can design its equipment with narrower emissions.

(2) Measurement Technique

55. When determining the shape of a frequency mask, it is essential that instrumentation requirements and measurement procedures are defined. In general, transmitter emissions are measured using established industry standards. In this connection, EIA/TIA Standard 603 instructs radio manufacturers to use a resolution bandwidth of 300 Hz or less.¹²⁸ Consistent with this standard, in the *R&O*, we determined that emissions of equipment designed to operate in the Refarming bands should be measured using a resolution bandwidth of 100 Hz with the measuring instrument in a peak hold mode.¹²⁹

¹²⁴ See *R&O* at paras. 79-80.

¹²⁵ SEA Petition for Reconsideration at 8.

¹²⁶ SEA Petition for Reconsideration at 9. SEA asserts that the emission mask for 6.25 kHz channels will overlap the emission mask on the adjacent channel 6.25 kHz away, thereby precluding the use of that adjacent channel. See SEA Petition for Reconsideration at 4.

¹²⁷ SEA Petition for Reconsideration at 9.

¹²⁸ See EIA/TIA Standard 603, Section 2.2.11 - Methods of Measurement for Transmitters, Sideband Spectrum.

¹²⁹ See 47 C.F.R. §§ 90.210(d)(4), 90.210(e)(4), and 90.210(m).