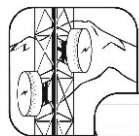


“Narrowbanding” 101

Management Briefing Number 9

ONE OF A SERIES OF NOTES ON
TECHNOLOGY FROM ADCOMM

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This brief paper evaluates the nontechnical issues related to FCC mandated frequency re-farming or “narrowbanding.” It is written to give managers and others a basic nontechnical understanding of the issues and challenges they will face as a result of this mandate. The use of some technical jargon is unavoidable, but the terms are explained as needed.

“Narrowbanding” 101

Technically, it’s known as “Re-Farming.” More commonly, it’s called “Narrowbanding.” Either way, if you’re involved with public safety odds are you’re going to be familiar with it. The Federal Communications Commission (FCC) has ordered a change in how most radios operating on frequencies below 512 MHz work, and since more than 85 percent of public safety agencies use radios that are affected, there is a good chance you, as a manager, will have a new project.

Simply put, the change requires VHF and UHF radios to use less radio bandwidth (a.k.a. spectrum) thus leaving the vacated spectrum to form new channels. The FCC has decided to implement the change in two steps or phases. Under phase 1 your usable bandwidth will be halved, leaving the other half to create a new channel thus doubling the amount of channels. In phase 2 it will be halved again resulting in four times the number of original channels. The channel split won’t be right down the middle. Instead, one-fourth of the space will be shaved from the upper channel limit and one-fourth will be shaved from the lower limit. Your original channel will be left intact but a whole lot “narrower.” Before January 1, 2013, all new radio equipment will have to meet the phase 1 requirements and user licenses will have to be modified to reflect the change. No date has been set for phase 2, but typically it would be sometime beyond the expected life (8 years or so) of equipment purchased in 2012.

It’s important to consider that it’s likely all of your radios, repeaters, base stations, mobiles, and portables will have to be programmed, physically altered, or replaced to comply with this change. Although it may sound easy, the trouble is in the details. Chances are that your entire network is operating in “wideband” 25 kHz channel spacing. Within the next few years, you are going to have to narrowband all at once. Yes, every radio on a particular channel, pretty much all at once. Mixing wideband and narrowband radios on the same frequency creates a variety of problems, best avoided given public safety’s mission. Think about it—all of law at once, all of fire, and/or EMS at once. Not to mention equipment replacements, very busy radio vendors, and government administrators that want to know what’s happening. FCC license modifications, determining existing radio inventory, change execution and management, funding, testing, contingency planning, and coverage impacts—now that’s a full blown project.

Why and How

The FCC was organized by congress in 1934 to regulate, among other things, an extremely popular technology referred to as radio. Through the decades, the FCC made radio rules and regulations to keep pace with ever-expanding use and more complex technology. As radio technology advanced, so did the need and appetite for radio spectrum. The problem was and is, is that there is a finite amount of it. When you have a limited amount of something everyone wants, the principles of supply and demand kick in, and usually things get expensive and complicated. Left alone, the available radio spectrum would eventually reach saturation and theoretically not be able to serve another user without causing debilitating interference. Granted, this observation is

offered in the simplest of terms. Other factors, such as distance, terrain, power, and technology factor into the mix and may allow many users in this limited space. But, eventually, the spectrum would reach an operational choke point. Starting in 1992, the FCC developed and adopted rules to promote the effective and efficient use of radio spectrum bands and has revised them several times since. And through the process, the current state of narrowbanding was born.

Narrowbanding is a process to make better use of the finite radio spectrum by using technology to reduce the amount of space or bandwidth a radio signal needs to operate on the spectrum. It's like being able to fit more cars on a highway by reducing their physical size or being able to park more cars in a parking lot by repainting the lines closer together. Today, radios operating below 512 MHz including VHF and UHF are licensed by the FCC to generally operate within a 25 kHz band of spectrum. This bandwidth is required to be able to carry voice or data. The frequency or channel you are licensed for is the midpoint of that bandwidth. Therefore, your radio can operate 12.5 kHz above and 12.5 kHz below your licensed frequency (see Figure 1). The next licensee in your immediate area could be operating at the midpoint of the next 25 kHz of bandwidth and so forth to the end of the band. The amount of bandwidth needed for VHF frequencies or channels is slightly wider at 30 kHz and the same principle applies. The midpoint is the licensed frequency and the operational bandwidth is 15 kHz above and 15 kHz below. There are a few caveats as to how VHF frequencies are organized but for this illustration we will keep it simple.

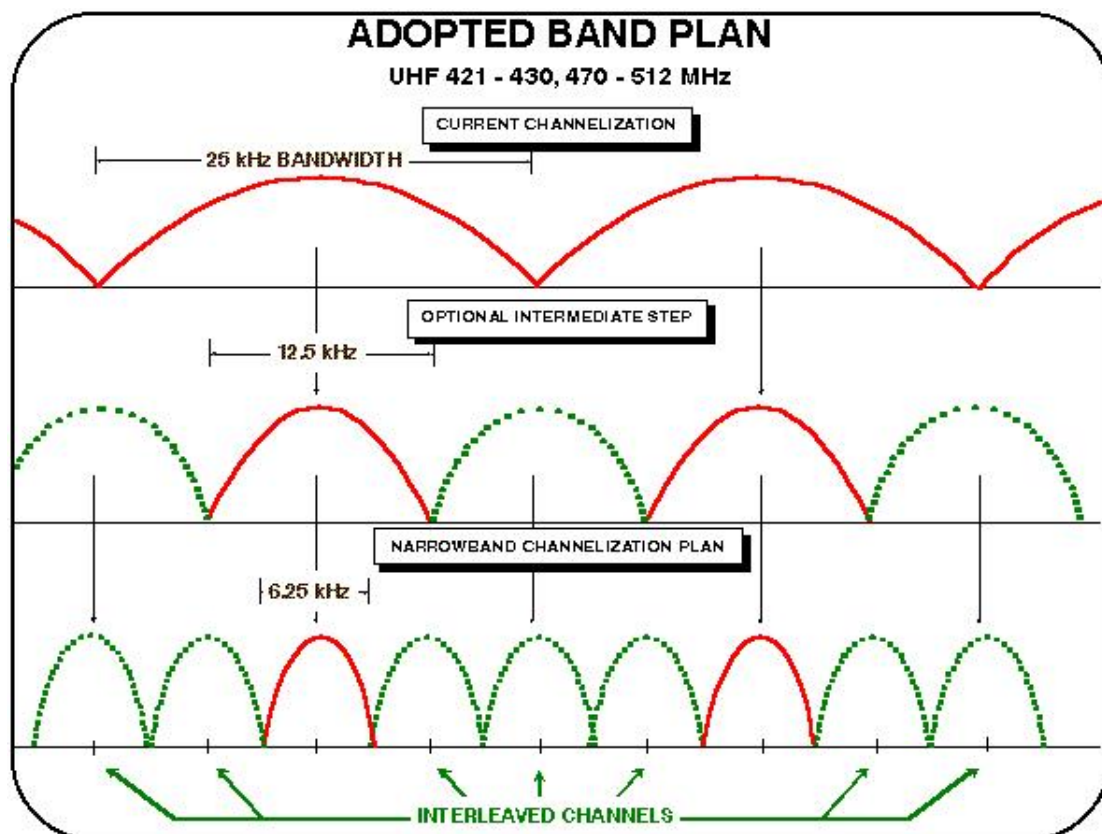


Figure 1. Adopted Band Plan

It's easy to imagine, if you have limited amount of space, only so many frequencies or channels will fit in to it. To make more channels available, the FCC decided to shrink by half the amount

of bandwidth a radio uses. The half that is left becomes the new channel. The space one channel used to occupy is now divided into two channels (see Figure 2). One channel now becomes two. Your 25 kHz channel now becomes 12.5 kHz.

The migration to narrowband will be made in two steps or phases (see Figure 2). Under phase 1, a radio will operate 6.25 kHz above and 6.25 kHz below the licensed frequency reducing the total bandwidth by half from 25 kHz to 12.5 kHz doubling the total amount of channels (see Figure 2). Phase 2 halves the operating bandwidth again making the total channel bandwidth 6.25 kHz, 3.25 kHz above and 3.25 kHz below your licensed frequency. The number of narrowband channels doubles again. Most radios manufactured after 1997 should be capable of effectively operating on both the new parameters and old bandwidths so transition to phase 1 can take place as part of a planned deployment any time before January 1, 2013. One important note worth mentioning is that the FCC has not identified a deadline for phase 2 because the Commission felt that the 6.25 kHz technology has not matured enough to set a migration deadline.

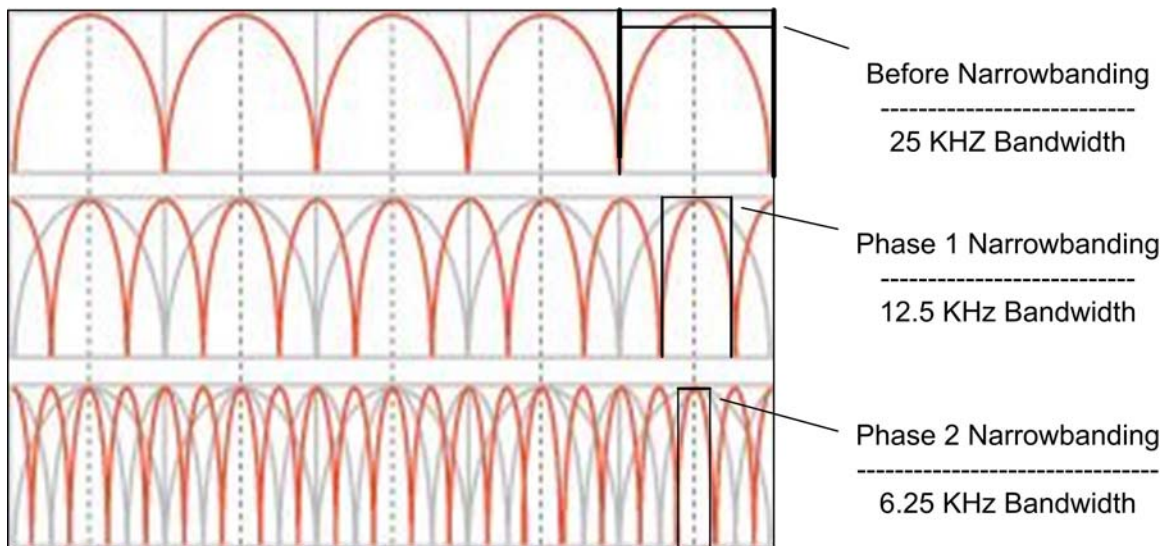


Figure 2. Narrowbanding Phases

Narrowbanding Pros and Cons

The re-use of spectrum created by narrowbanding should ensure plenty of new channels for future users and emerging technologies—that's good news for public safety. The characteristics of radio signals in these bands lend themselves to the types of environments emergency service personnel operate in. As a result, the VHF and UHF radio spectrum have become the workhorses of law, fire, and EMS. According to the Police Chief's Association, over 85 percent of all emergency services in the United States use radios impacted by narrowbanding rules.

While some users have migrated to narrowband already, most have not and will have to do so before January 1, 2013. The rush to meet the deadline will likely cause equipment shortages as manufacturers struggle to meet the demand and radio shop scheduling problems occur as customers line up. Interference, loss of coverage, incompatible equipment, and other problems are bound to occur as the migration takes place. Unanticipated difficulties will also likely crop up as so many users switch to narrowband operations.

Narrowbanding of analog radio systems will cause a loss of coverage. The outer fringes of your radio coverage will most likely be affected. Simply put, where you once had coverage now you don't. This is perhaps, the most negative functional impact of narrowbanding. Most field users learn their radio systems over time, and for the most part they know where radios work and where they do not. This process is going to change your coverage. The cause of this phenomenon is related to the physics of the narrower signal, but it's not as important as knowing where and if you can expect it to happen. It is recommended that as a part of the planning process computer coverage contours are prepared. These models can give you a good idea of how fixed base stations and repeaters will likely be impacted. Digital radio systems are not expected to experience a loss of coverage as a result of narrowbanding. Still, a computer propagation model can be a very useful tool to ensure that is indeed the case.

The computer propagation model in Figure 3 illustrates the effects of phase 1 narrowbanding. The red and green color contours together illustrate the coverage that is generally expected in the wideband 25 kHz environment. The green only illustrates the expected coverage after narrowbanding to 12.5 kHz. Everywhere shaded in red is lost coverage area once the switch is made to narrowband operation. As you can see, the model predicts lost coverage along several roads. The time to discover the loss is not during an emergency. This type of modeling can be very valuable for educating users about what to expect and predicting coverage needed to assist decisionmaking.

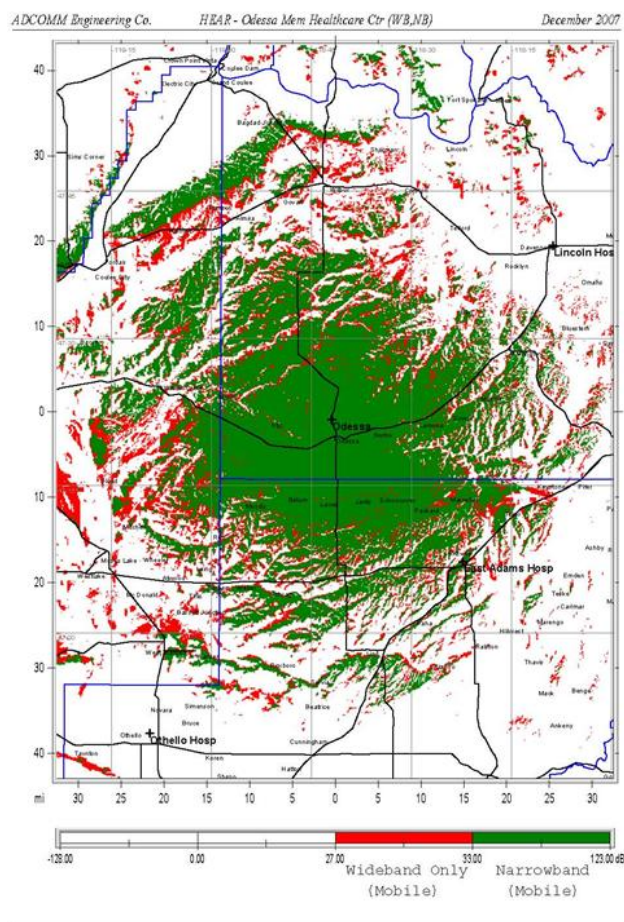


Figure 3. Coverage Map

On the upside, when re-farming is complete, about four times as many channels will be available in the spectrum under 512 MHz. On the downside, getting there and lost coverage will be challenging.

Planning and Budgeting for Narrowbanding

Preparation for narrowbanding will require the same commitment of time, resources, and budgeting that any radio project would, perhaps more. Because this project will impact all radio users in your emergency services community, someone or some group will have to be given the authority to manage the project and make important decisions. Remember, the clock is ticking. As of this printing, there's about 4-½ years left. Although that seems like a lot of time, consider that virtually everyone is going to be doing this almost all at once. The point is you need to start now and a good starting point is to make sure elected officials are aware of what's going on and the time constraints you're under. As a side note if you think the FCC is going to change the deadline because we as a group are not ready, think again. Organizations have begun applying for and using narrowband frequencies. Remember, one half of the wideband frequency is part of two new narrowband frequencies. Therefore, adjacent frequency users will literally be on a wideband user's frequency. The bottom line is, the cat's out of the bag, and there's no going back now.

The process is going to require some homework on your part. You will need to fully understand the narrowbanding objectives and responsibilities. ADCOMM provides a free planning guide (www.adcommeng.com). Awareness is the first step. You will need to identify and have discussions with user groups (Law, Fire, EMS), elected officials, radio vendors, and interoperable partners. A realistic budget will have to be prepared as man hours and equipment will be needed. A complete system inventory and evaluation is necessary and a timeline for the project should be developed and agreed upon. Equipment will have to be replaced, programmed, or modified as necessary. A cutover plan needs to be formalized and your FCC licenses need to be modified and perhaps new frequencies need to be applied for. Finally, there's cutover and it's back to business as usual. Remember, projects change again and again. Your ability to manage the effects of the changes will determine your success. Carry out the plan and review the results. Um, did I mention phase 2. If you determine your system is phase 2 capable (able to operate within a 6.25 kHz bandwidth), the FCC is recommending you make the leap now. The same principles apply.

The Very Latest From the FCC

On May 13, 2008, the FCC released the "Fourth Memorandum Opinion and Order." The memo summarizes the history of the other orders and provides a foundation for understanding the idea of the two-phased narrowbanding approach. The memorandum is included in this document on the following pages. The formatting has been changed slightly to enhance readability.

FOURTH MEMORANDUM OPINION AND ORDER

Adopted: May 12, 2008 Released: May 13, 2008

By the Commission:

I. INTRODUCTION

1. In the *Third Report and Order* in this proceeding, the Commission indicated that it intends to establish a fixed timeline for private land mobile radio (PLMR) licensees to transition to 6.25 kHz technology, but did not at that time establish specific dates.¹ In this *Fourth Memorandum Opinion and Order*, we address a petition for reconsideration and a request for clarification of the *Third Report and Order*. Specifically, we clarify that a notice of proposed rulemaking will be released prior to adoption of a 6.25 kHz technology transition schedule; and that language in the *Third Report and Order* encouraging licensees to consider migrating directly to 6.25 kHz technology was not intended to dissuade migration to 12.5 kHz technology by licensees that have already begun the process.

II. BACKGROUND

2. Earlier in this proceeding, the Commission took the following actions in order to bring about a timely transition to narrowband technology: (1) set January 1, 2013, as the deadline for Industrial/Business and Public Safety Radio Pool licensees in the 150-174 MHz and 421-512 MHz bands to either migrate to 12.5 kHz technology, or utilize a technology that achieves equivalent efficiency; (2) prohibited any applications for new systems using 25 kHz channels, or modification applications that expand the authorized contour of an existing 25 kHz station, effective January 1, 2011; (3) prohibited the manufacture and importation of any 150-174 MHz or 421-512 MHz band equipment capable of operating with only one voice path per 25 kHz of spectrum, *i.e.*, equipment that includes a 25 kHz mode, beginning January 1, 2011; and (4) prohibited the certification of any equipment that includes a 25 kHz mode beginning January 1, 2011.²
3. In the *Second Further Notice of Proposed Rule Making* in this proceeding, the Commission sought comment on whether measures similar to those adopted to encourage the migration to 12.5 kHz narrowband technology should also be implemented to facilitate migration to 6.25 kHz technology.³ Noting that 12.5 kHz technology was a transitional standard to facilitate migration to 6.25 kHz technology, the Commission tentatively concluded that similar measures would

¹ See Implementation of Sections 309(j) and 337 of the Communications Act of 1934 as Amended; Promotion of Spectrum Efficient Technologies on Certain Part 90 Frequencies, *Third Report and Order*, WT Docket No. 99-87, RM-9332, 22 FCC Rcd 6083, 6088 ¶ 10 (2007) (*Third Report and Order*).

² See 47 C.F.R. §§ 90.203(j), 90.209(b); see also Implementation of Sections 309(j) and 337 of the Communications Act of 1934 as Amended; Promotion of Spectrum Efficient Technologies on Certain Part 90 Frequencies, *Second Report and Order and Second Further Notice of Proposed Rule Making and Order*, WT Docket No. 99-87, RM-9332, 18 FCC Rcd 3034 (2003) (*Second Further Notice*); Implementation of Sections 309(j) and 337 of the Communications Act of 1934 as Amended; Promotion of Spectrum Efficient Technologies on Certain Part 90 Frequencies, *Third Memorandum Opinion and Order, Third Further Notice of Proposed Rule Making and Order*, WT Docket No. 99-87, RM-9332, 19 FCC Rcd 25045 (2004). Language relating to the 2013 deadline was erroneously deleted from Section 90.209(b)(5) of the Commission's Rules, 47 C.F.R. § 90.209(b)(5), in an unrelated rulemaking proceeding last year. See Amendment of Part 90 of the Commission's Rules, *Notice of Proposed Rulemaking and Order*, WP Docket No. 07-100, 22 FCC Rcd 9595, 9629 (2007). We take this opportunity to correct the error and restore the deleted language. Moreover, as a portion of the deleted passage was worded in a slightly imprecise manner, we have revised it. We find that notice and public procedure are unnecessary because this amendment of the rules is non-substantive in nature and simply increases the ease of reference to previously established obligations. Accordingly, for good cause, we are revising the rule as set forth in the Appendix, pursuant to the notice and comment exceptions of 5 U.S.C. § 553(b).

³ See *Second Further Notice*, 18 FCC Rcd at 3045 ¶ 27.

FOURTH MEMORANDUM OPINION AND ORDER (continued)

facilitate migration to 6.25 kHz technology.⁴ It also sought comment on a date or dates by which licensees must migrate to 6.25 kHz technology.⁵

4. In the *Third Report and Order*, however, the Commission declined to establish a fixed date for users to transition to 6.25 kHz technology, because it agreed with the majority of commenters “that adopting such a measure would be premature, and . . . more time is warranted to allow further development and field testing of the 6.25 kHz [interoperability] standard.”⁶ The Commission nonetheless reiterated that 12.5 kHz technology is a transitional step in the eventual migration of PLMR systems to 6.25 kHz technology, and it stated, When that technology matures to the point that sufficient equipment is available for testing, we will expeditiously establish a transition date for users to convert to that more spectrum-efficient technology. . . . Given that the Commission will adopt a date by which users must migrate to 6.25 kHz technology, we strongly urge licensees to consider the feasibility of migrating directly from 25 kHz technology to 6.25 kHz technology prior to January 1, 2013. Such a course could be more efficient and economical than first migrating to 12.5 kHz technology by 2013, then further migrating to 6.25 kHz technology thereafter.⁷
5. Two petitions were filed in response to the *Third Report and Order*. First, Kenwood USA Corporation, Communications Sector (Kenwood) requests that we clarify that the Commission’s statement urging licensees to consider migrating directly to 6.25 kHz technology was not intended to delay or discourage migration to 12.5 kHz technology.⁸ It reports that the *Third Report and Order* has caused end-users, including entities that already were in the process of converting to 12.5 kHz technology in order to comply with the 2013 deadline, to adopt a “wait and see” approach rather than invest in 12.5 kHz equipment that may be rendered obsolete before the end of its useful life.⁹ The City of New York (New York) echoes Kenwood’s concern that an early date for 6.25 kHz migration would result in stranded investment, and raises other concerns.¹⁰ New York urges the Commission to release a notice of proposed rulemaking prior to adoption of a 6.25 kHz technology transition date, in order to allow licensees an opportunity to plan and implement a reasoned migration path.¹¹ The commenters to New York’s petition unanimously support this request.¹²

III. DISCUSSION

6. As an initial matter, we are cognizant of the concerns raised by New York and commenters supporting New York’s petition that their 12.5 kHz equipment not be rendered obsolete prematurely.¹³ Accordingly, we clarify that we intend to provide notice and seek comment prior

⁴ *Id.* (citing Replacement of Part 90 by Part 88 to Revise the Private Land Mobile Radio Services and Modify the Policies Governing Them, *Report and Order and Further Notice of Proposed Rule Making*, PR Docket No. 92-235, 10 FCC Rcd 10076, 10095 ¶ 28 (1995) (*Refarming Report and Order*)).

⁵ *Id.*

⁶ *Third Report and Order*, 22 FCC Rcd at 6088 ¶ 10.

⁷ *Id.* at 6088-89 ¶ 11.

⁸ Letter dated May 9, 2007 from Christopher D. Imlay, Regulatory Counsel, Kenwood USA Corporation, Communications Sector to Fred Campbell, Chief, Wireless Telecommunications Bureau, at 3.

⁹ *Id.*

¹⁰ Petition for Reconsideration of the City of New York at 1-3 (filed May 18, 2007) (New York Petition).

¹¹ *Id.* at 1, 11.

¹² Association of American Railroads (AAR), Association of Public-Safety Communications Officials-International, Inc. (APCO), Enterprise Wireless Alliance, Land Mobile Communications Council (LMCC), Motorola, Inc. (Motorola), Nassau County Fire and Rescue Services, Nassau County Police Department, National Public Safety Telecommunications Council, State of California, and Utilities Telecom Council filed comments. In addition, Icom, Inc. filed an *ex parte* statement.

¹³ See New York Petition at 6; AAR Comments at 1-2, 9; APCO Comments at 2; LMCC Comments at 2; Motorola Comments at 4. We note that throughout the rulemaking proceedings regarding PLMR narrowbanding, the Commission has been cognizant of licensees’ desire to maximize the useful life of their equipment. See *Second Further Notice*, 18 FCC Rcd at 3041-42 ¶¶ 18-19; *Refarming Report and Order*, 10 FCC Rcd at 10099 ¶ 37.

FOURTH MEMORANDUM OPINION AND ORDER (continued)

to adopting final rules establishing a 6.25 kHz migration schedule,¹⁴ and thus grant New York's petition to that extent. At that time, interested parties will have an opportunity to comment on such a proposal.

7. We are aware that many licensees of larger, more complicated systems have already commenced the transition to 12.5 kHz technology in order to comply with the 2013 deadline. We applaud these efforts, and do not believe that they should be suspended or abandoned. We therefore clarify that the language in the *Third Report and Order* urging licensees to consider migrating directly to 6.25 kHz technology was not intended to dissuade migration to 12.5 kHz technology by licensees that have already begun the process. To that extent, we grant the Kenwood petition.
8. We reiterate, however, that 12.5 kHz technology is a transitional step in the eventual migration of PLMR systems to 6.25 kHz technology. As the demand for scarce PLMR spectrum continues to grow, the Commission will closely monitor the progress made by standards-setting organizations and equipment manufacturers to develop more spectrum-efficient PLMR systems. As we indicated in the *Third Report and Order*, when 6.25 kHz technology matures to the point that sufficient equipment is available for testing, we will expeditiously establish a transition date for users to convert to that more spectrum-efficient technology. Consequently, licensees that may not migrate to 12.5 kHz technology until the January 1, 2013, deadline approaches should consider the feasibility of migrating directly to 6.25 kHz technology. Such a course could be more efficient and economical for licensees—and result in greater overall spectrum efficiency—than first migrating to 12.5 kHz technology by 2013, then further migrating to 6.25 kHz technology thereafter.

IV. PROCEDURAL MATTERS

9. 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).

V. ORDERING CLAUSES

10. Accordingly, IT IS ORDERED that pursuant to Sections 4(i) and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 303(r), and Section 1.2 of the Commission's Rules, 47 C.F.R. § 1.2, the Request for Clarification filed by Kenwood USA Corporation, Communications Sector on May 9, 2007 IS GRANTED to the extent set forth herein.
11. IT IS FURTHER ORDERED that pursuant to Sections 4(i) and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 303(r), and Section 1.429 of the Commission's Rules,

¹⁴ It is not unusual for the Commission to reach a general decision, such as the decision ultimately to adopt rules mandating migration to 6.25 kHz technology, while deferring adoption of final rules implementing the decision to further notice-and-comment rulemaking proceedings. See, e.g., Digital Audio Broadcasting Systems and Their Impact on the Terrestrial Radio Broadcast Service, *Second Report and Order, First Order on Reconsideration, and Second Further Notice of Proposed Rulemaking*, MM Docket No. 99-325, 22 FCC Rcd 10344 (2007) (resolving operational and other issues that were presented in the *Further Notice of Proposed Rulemaking* in that proceeding after the *Report and Order* selected in-band, on-channel as the technology enabling AM and FM radio broadcast stations to commence digital audio broadcasting); Review of Part 87 of the Commission's Rules Concerning the Aviation Radio Service, *Second Report and Order and Second Further Notice of Proposed Rule Making*, WT Docket No. 01-289, 21 FCC Rcd 11582, 11590-92 ¶¶ 13-14 (2006) (concluding that Aeronautical Mobile Satellite (Route) Service should be licensed under Part 87 as well as Part 25, but deferring implementation of the policy pending the resolution of flexibility and priority issues).

FOURTH MEMORANDUM OPINION AND ORDER (continued)

47 C.F.R. § 1.429, the Petition for Reconsideration filed by City of New York on May 18, 2007 IS GRANTED to the extent set forth herein.

12. IT IS FURTHER ORDERED that Part 90 of the Commission's Rules IS AMENDED as specified in the Appendix, effective 30 days after publication in the Federal Register.

FEDERAL COMMUNICATIONS COMMISSION
Marlene H. Dortch, Secretary

Narrowbanding Highlights

- According to the National Institute of Justice, agencies that do not meet the deadline face the loss of communications abilities.
- A great deal of information about narrowbanding on the internet is out of date or incorrect. Be sure about your sources.
- The FCC settled on the current course of action in late 2004.
- Generally, all licensed radios operating below 512 MHz, including portables, mobiles, base-stations, control-stations, and repeaters, whether conventional or trunked must be phase 1 narrowband compliant before January 1, 2013.
- All associated licenses must be properly modified by January 1, 2013.
- The ultimate goal of the FCC is to have one voice channel for every 6.25 kHz of bandwidth known as phase 2. However, no completion date currently exists for phase 2 compliance.
- Applications for wideband operations (25 kHz channels) will be accepted until January 1, 2011.
- **Paging-only** frequencies are exempt from this mandate.
- The FCC will prohibit the manufacture or import of any equipment that operates on 25 kHz channels after January 1, 2011.
- The new narrowband channels are available for licensing now. Remember, other users may still be operating on adjacent channels at 25 kHz bandwidths creating the potential for interference.
- Any LMR (land mobile radio) equipment sold today must be capable of operating at the 12 kHz bandwidth.

Useful Web Links

<http://wireless.fcc.gov/services/index.htm>

Link to FCC Index

<http://www.lmcc.org/>

Link to Land Mobile

<http://www.apcointl.org>

Link to APCO

<http://www.nena.org/>

Link to National Emergency Number Association

<http://www.apcointl.com/frequency/documents/NarrowbandOrder.html>

Link to APCO Narrowbanding Information

<http://www.apcointl.org/frequency/issues.htm>

Link to APCO Frequency Issues Page

<http://policechiefmagazine.org/magazine>

Link to Police Chief Magazine