



6.25 kHz FDMA Information Center

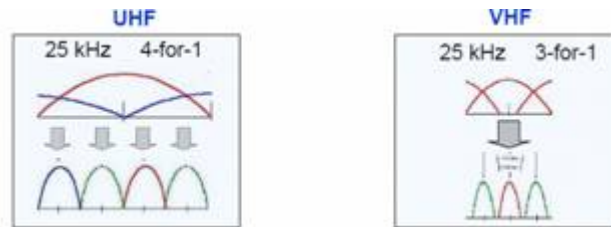
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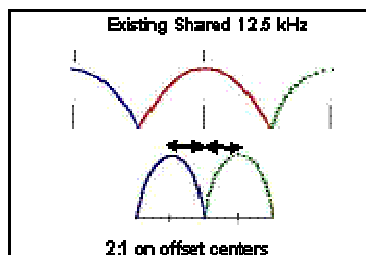
Recent L.M.C.C. Decisions Favorable to 6.25 kHz FDMA Licensing

The LMCC held a meeting recently to address issues about licensing our 6.25 kHz FDMA technology:

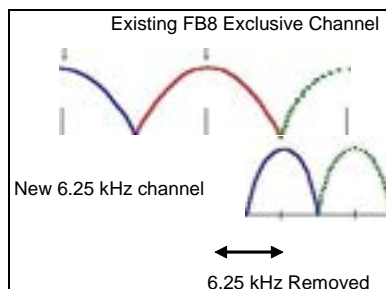
Exclusive Channels - Exclusive channels are about 20% of licenses. No one else is on them (uses FB8 classification). The LMCC decided they can do anything they want (“exclusive”) including 2:1, 4:1 splits.



Shared Channels – They agreed to split 12.5 kHz channels 2:1 (previously they would only split “exclusive channels”). This is new because previously they would only coordinate 6.25 kHz licenses on the center frequency of 12.5 kHz channels (no advantage). Now they will license on the 6.25 kHz “offset” frequencies within the 12.5 kHz channel. They agreed that no waiver was necessary under the current rules.



Adjacent to exclusive channels - They protect the rights of exclusive channels (3,300) by preventing adjacent channel interference with a “buffer” between the new license and the exclusive license. New 6.25 kHz channels are “dropped in” between existing 12.5 kHz exclusive channels. Now they will allow as close as 6.25 kHz from the center of the 12.5 kHz channel.



This was a very good meeting as the LMCC is now moving aggressively to license 6.25 kHz channels in these 3 ways.



4 Level FSK/FDMA 6.25kHz Technology



Icom America Inc.

2380 116th Ave NE, Bellevue, WA 98004

New Digital Land Mobile 6.25kHz Technology

As existing spectrum becomes increasingly scarce, the demand for more options grows. The FCC essentially created additional spectrum by adding hundreds of new licenses with 6.25kHz bandwidth. To take advantage of this opportunity, Icom and Kenwood entered into a joint agreement to develop 6.25kHz technology. This technology is a new digital communications protocol that provides quality voice and data, and is designed as a non-proprietary protocol. It accomplishes this by using 4LFSK (4-Level Frequency Shift Keying) and FDMA (Frequency Division Multiple Access).

History

This technology was developed in response to an FCC revision of the rules concerning transmitters in the 150MHz to 174MHz and 421MHz to 512MHz range. To receive FCC certification after January 1st, 2005, transmitters must have proved compliant as a multi-mode device. This requirement could be achieved by using 6.25kHz channel bandwidth. In addition to the FCC requirement, Europe and Japan are also moving toward 6.25kHz technologies. Because some in the industry believed that this requirement could not be met by 2005, the FCC suspended this requirement.

Even with the FCC deferring narrowband conversion over a ten year period, Icom set out to meet the requirement without delay. This was impossible using analog technology, so it became necessary to develop a new digital protocol. Other methods were also considered, including ACSB and the proposed APCO Project 25 (P25) Phase II CQPSK. However, both required a more expensive linear amplifier in the transmitter and neither is compatible with existing analog FM hardware.

Instead, 4LFSK modulation was selected using FDMA for transmission. This method has a number of advantages:

- better communication range
- simpler design
- easy to maintain and service
- lower cost for business and industry customers
- compatible with existing FM radio hardware

Icom's first radio with this technology is the F3061/F4061. To enable backwards compatibility, the radio is both analog and digital and also works in 25kHz and 12.5kHz channel bandwidths (conventional and LTR® trunked operation in analog mode).



Backwards compatibility to analog only radios enables a planned migration path to “digital” with existing radios operating analog only and new radios operating analog and digital.

How the Technology Works

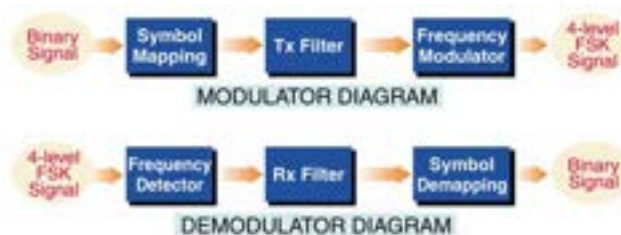
General specifications:

- Access method: FDMA
- Transmission rate: 4800 bps
- Modulation: 4-level FSK
- Vocoder: AMBE+2
- Codec rate: 3600 (voice 2,450 + error correction 1,150 bps)

Modulation with 4LFSK uses a symbol mapping scheme. When the radio receives a binary number, that number is mapped to a symbol, which is interpreted as a 1050Hz frequency deviation.

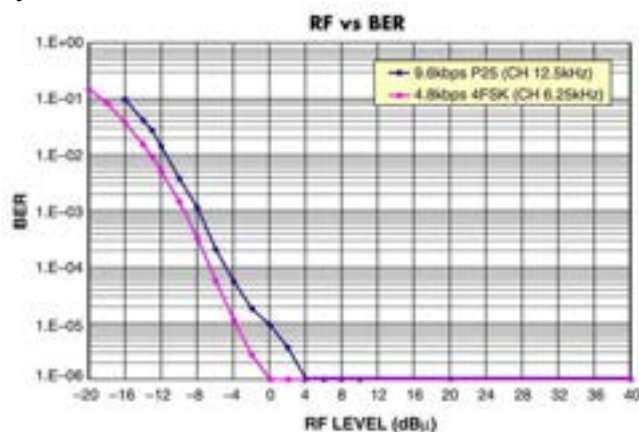
Information	Symbol	Deviation
01	+ 3	+ 1050Hz
00	+ 1	+ 350Hz
10	- 1	- 350Hz
11	- 3	- 1050Hz

During demodulation, that deviation is detected, filtered and “unmapped” as a binary signal for transmission.



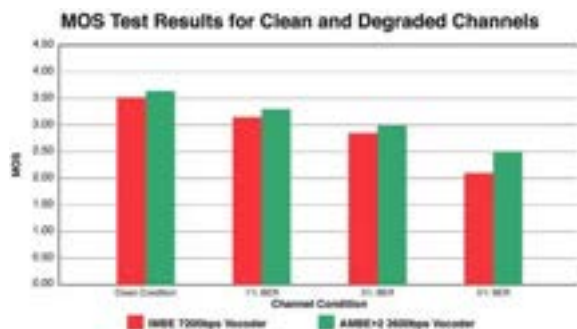
Signal Quality

The FDMA signal BER performance exceeds that of P25 phase 1 radios, which have already been accepted by the LMR market.



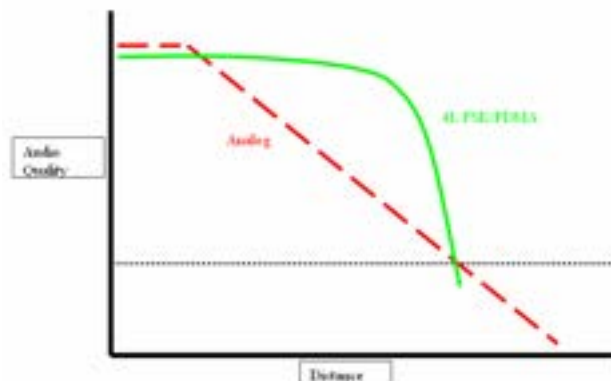
Audio Quality

The 6.25kHz technology also offers superior audio quality compared to P25 audio. Test engineers using a Mean Opinion Sample (MOS) found the audio quality was uniformly better, ranging from clean conditions to 5% BER. Using the AMBE+2 Vocoder in the Icom IC-F3061 makes this possible.



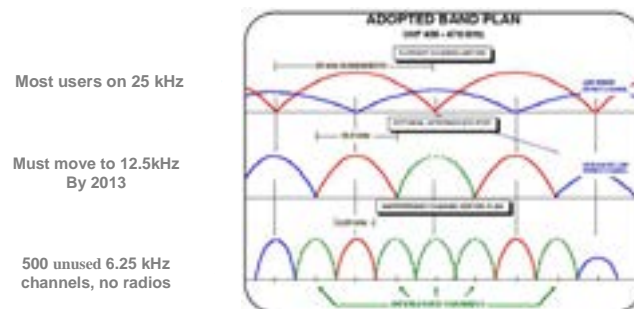
Range

Audio quality over distance is also greatly improved with Icom's 6.25kHz technology. Instead of the early degradation of audio that you see in an analog signal, the 6.25kHz digital audio quality remains higher over a comparable distance.



Spectrum Considerations (VHF & UHF)

While most users are operating on 25kHz channels, they will have to migrate to 12.5kHz bandwidth by 2013. Narrowband migration is currently impeded by the lack of incentives for end users to invest in the technology.

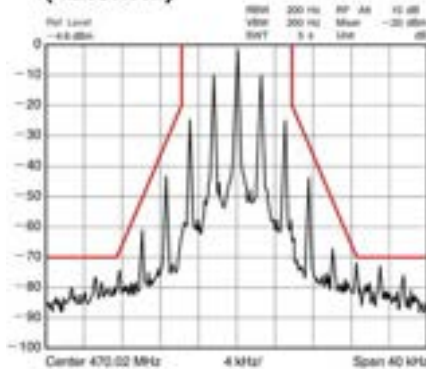


A channel is defined by the deviation either side of the center line frequency. Migrating from a 25kHz channel to a 12.5kHz channel on the same centerline frequency is a 1-for-1 move. There is no increase in the capacity to load radio users.

There are 500 new 6.25kHz frequencies (VHF and UHF) available now. Most are unused because no 6.25kHz radios were available. With Icom's FDMA technology, frequency coordinators have total flexibility to either assign a 6.25kHz channel within an existing 25kHz or 12.5kHz channel or as a stand-alone frequency somewhere else on the band.

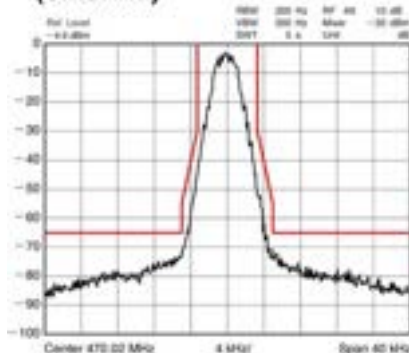
Frequency coordinator will coordinate channels for minimum adjacent channel interference. Because the emission mask is tight, 6.25kHz channels can be used next to each other without causing interference.

Existing Analog FM (12.5kHz)



The emission mask above is established by the FCC for 12.5kHz channels. The signal must operate within the mask.

Proposed Digital 4-Level FSK (6.25kHz)



This is the emission mask for a 6.25kHz channel. The Icom FDMA signal clearly operates within the mask. Accordingly, the FCC certified the F3061/F4061 as the first ever 6.25kHz radio.

UHF Considerations

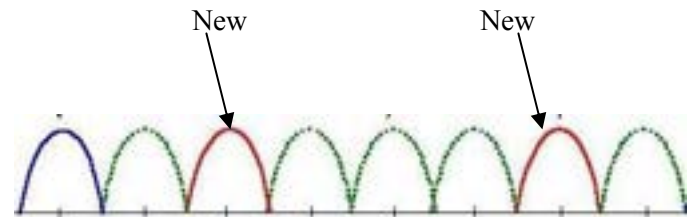
A number of frequency allocation options for 6.25kHz are available in UHF.

Note: the following options illustrate potential spectrum opportunities with 6.25kHz technology. Actual opportunities may vary by locale and other conditions.

Please check with your frequency coordinator for opportunities available in your location.

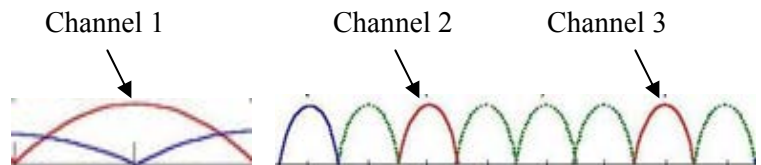
Obtain New 6.25kHz Frequencies

This may be the best option for a new radio user in a location where no channels are available. Each 6.25kHz frequency is unique. Existing 25kHz or 12.5kHz channels do not have to be “split.” This gives the greatest flexibility to the frequency coordinator.



Expand an Existing System

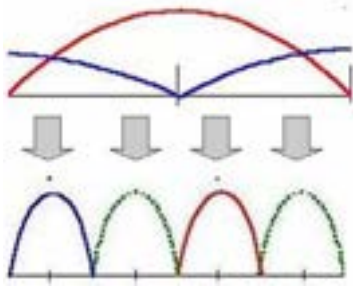
Spectrum holders can apply for some new additional 6.25kHz channels and combine them with their current 25 or 12.5kHz channels. New frequencies could occupy the existing 25kHz or 12.5kHz bandwidth. Additional stand-alone 6.25kHz channels could also be used.



Split a 25kHz or 12.5kHz Channel

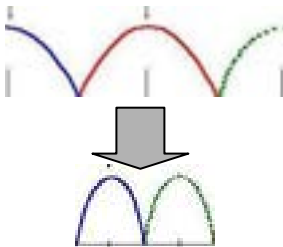
Both 2-for-1 and 4-for-1 efficiencies may be realized by splitting existing channels. Using 6.25kHz channels offset from the center of a 25kHz channel, it is possible to fit four 6.25kHz channels into the 25kHz bandwidth. To do this, a waiver from the FCC is required*. Using this scheme, the four frequencies are now offset 3.125kHz from the original 25kHz channel center frequency.

4-For-1



With a 12.5kHz channel, you can create two offset 6.25kHz channels.

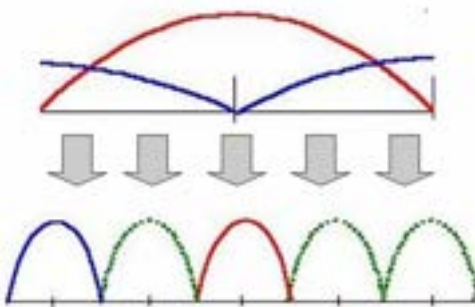
2-for-1



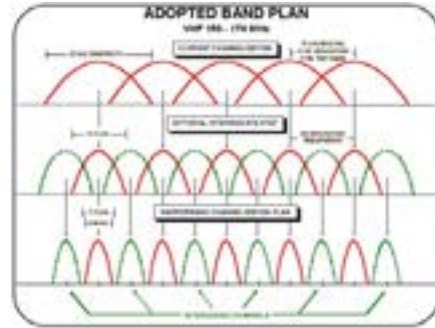
*Note: No waiver needed if a 12.5kHz channel is exclusive (FB8), under [90.173(j)]

Hedge Strategy

If you start at the center frequency, you can license 5 each 6.25kHz frequencies underlying a 25kHz channel. The 2 outer frequencies are out of the 25kHz channel width. This provides license holders with a “hedge” against losing that spectrum in 2013 when they will be forced to 12.5kHz.



VHF Considerations



VHF offers even more opportunities due to its original 30 kHz channel width plan. When the FCC moved to 25kHz and then 12.5kHz an overlap was created requiring geographical separation between two contiguous channels. For example, 3 contiguous could not be used at the same location.

The VHF narrowband plan is 7.5kHz channels, which has eliminated the geographical separation requirement. Tests have proven the Icom 6.25kHz signal can be used within a 7.5kHz channel with no interference to the adjacent channel.

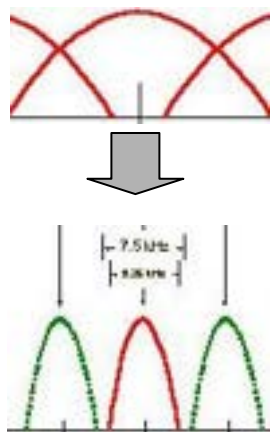
Split a 25kHz or 12.5kHz Channel

This is similar to the UHF application. With a 12.5 or 25kHz channel, you can create two or four offset 6.25kHz channels. This may require a waiver from the FCC.

One 25kHz Channel to Three 6.25kHz Channels

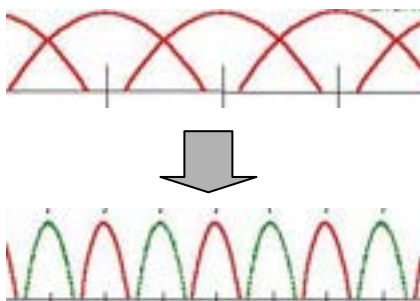
A single 25kHz channel can be converted to three 6.25kHz channels, each operating within a 7.5kHz channel.

This would entail one channel on the original center frequency with the other two on the new 7.5kHz centerline frequencies.



Three 25kHz Channels to Seven 6.25kHz Channels

Using 3 overlapping 25kHz channels under Part 22, you can fit seven 6.25kHz channels using 7.5kHz bandwidths.



Future Applications for 6.25 Technology

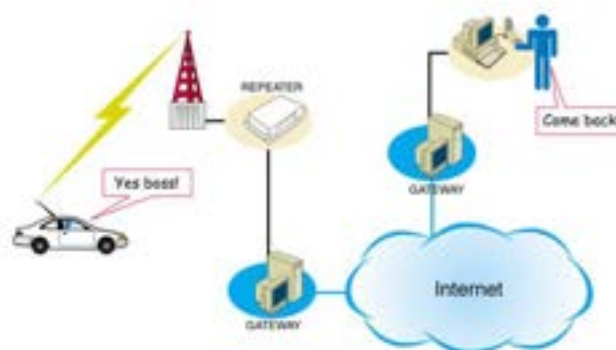
The new digital land mobile technology can be a platform for future integration of IT/IP/VOIP technologies. To this end, Icom, Kenwood, and Trident Micro Systems have formed a strategic alliance to develop a new generation of digital networking systems. The goal of this alliance is to allow seamless migration from analog systems to new digital technologies.

Multi-site IP Networks



In this example, a gateway to the internet is attached to each repeater. This enables networks to be built using the internet as part of the infrastructure.

Integrated PC and Radio



Here, the PC is connected to the internet to communicate through the remote repeater.

Press Release May 2006

“(Las Vegas, NV – May 16, 2006)

ICOM Incorporated, KENWOOD Corporation, and TRIDENT MICRO SYSTEMS announced today that they plan to form a strategic alliance to develop a new generation of digital networking systems. A strategic goal of this alliance will be to accommodate seamless migration from current analog systems to new digital technologies with boundary free expansion.”



Appendix A: Adjacent Channel Rejection Test Results

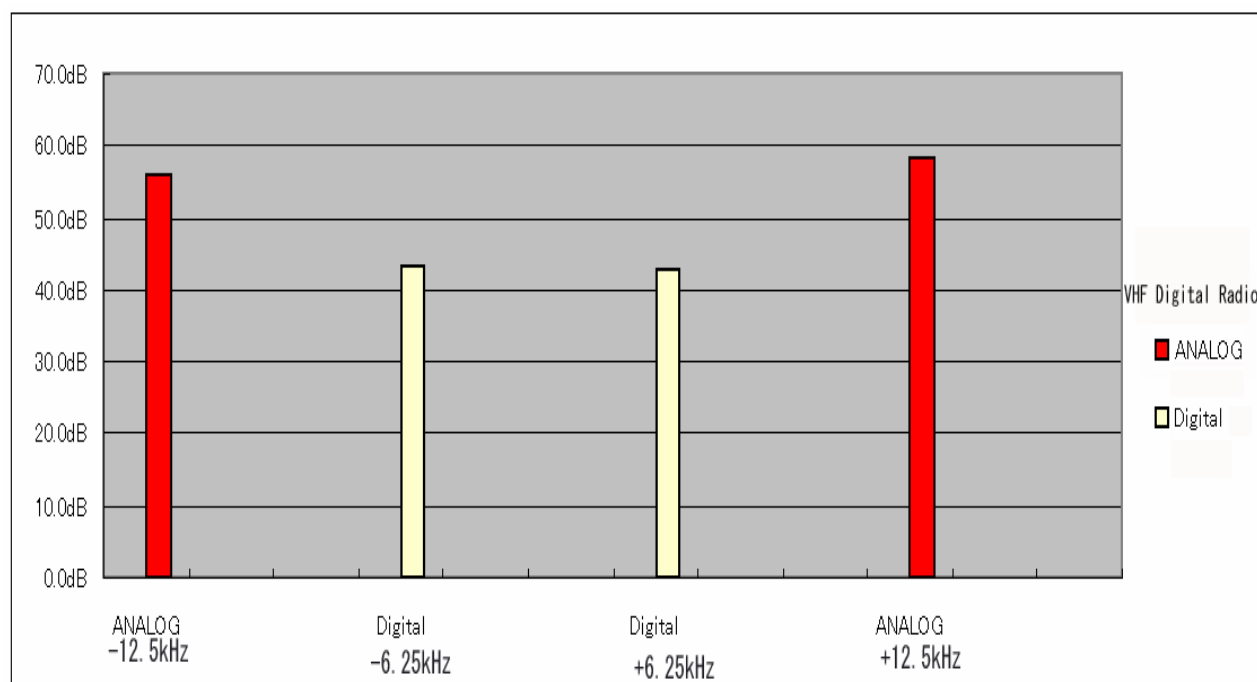
The adjacent channel rejection was compared between an analog mode (12.5kHz) and digital mode (6.25kHz). The following tests were conducted TIA-102.CAAA-B* measurement methods. The analog measurement method used is TIA-603-B.

*Transmission rate and modulation is different from TIA-102.CAAA-B

VHF Adjacent Channel Rejection - 6.25kHz Channels

The following charts show 6.25kHz adjacent channel rejection in digital mode operation*. This performance in digital operation exceeds the standard value of a Class B radio in analog operation at 12.5kHz. Icom intends to improve this performance further (compared to 12.5kHz analog mode) in the near future. This whitepaper will be revised to reflect any new data at that time.

VHF Analog 12.5kHz vs. Digital 6.25kHz Adjacent Channel Rejection



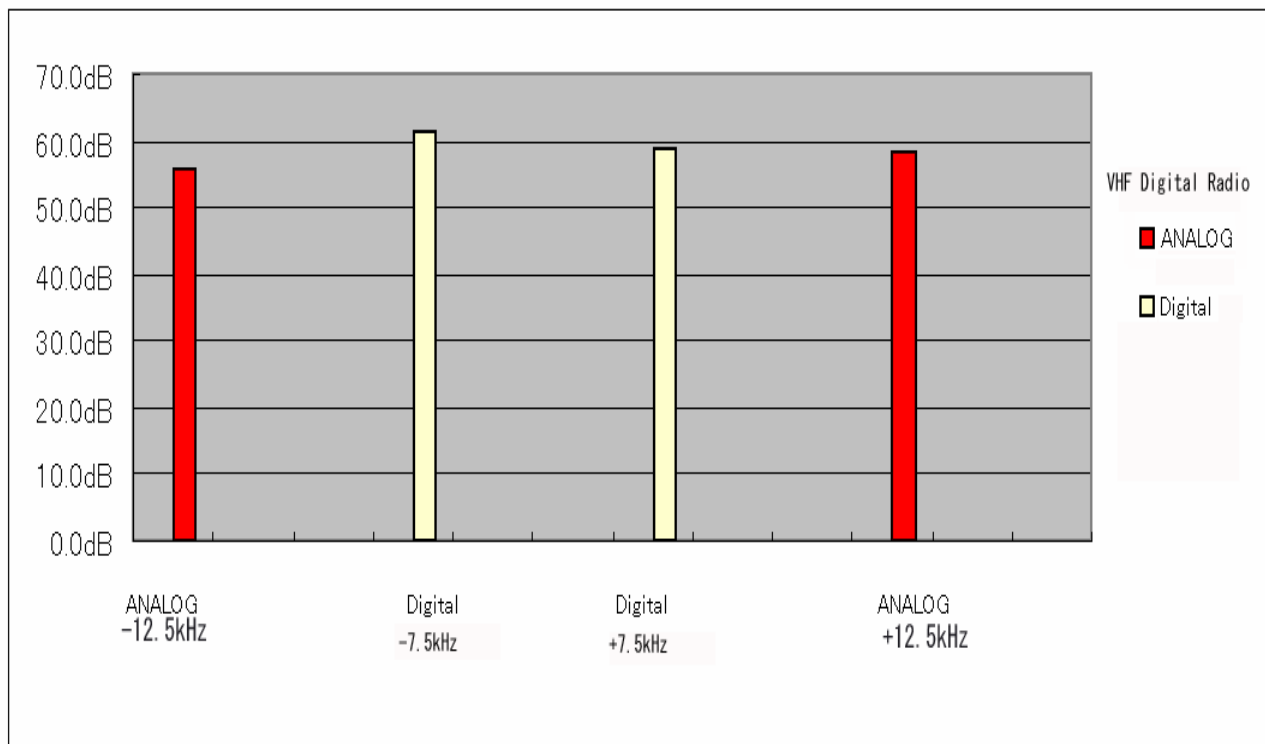
MODE	ANALOG	Digital	Digital	ANALOG
Δ Freq	-12.5kHz	-6.25kHz	6.25kHz	12.5kHz
Digital Radio	55.8dB	43.0dB	42.9dB	58.1dB
Measurement Method	TIA-603-B	TIA-102.CAAA-B		TIA-603-B
Class B (TIA-603-B)	40dB	-	-	40dB

*Transmission rate and modulation is different from TIA-102.CAAA-B

VHF Adjacent Channel Rejection - 7.5kHz Channels

The following charts show 7.5kHz adjacent channel rejection in digital mode operation*. This performance in digital mode is nearly equivalent to the performance in analog operation at 12.5kHz.

VHF Analog 12.5kHz vs. Digital 7.5kHz Adjacent Channel Rejection



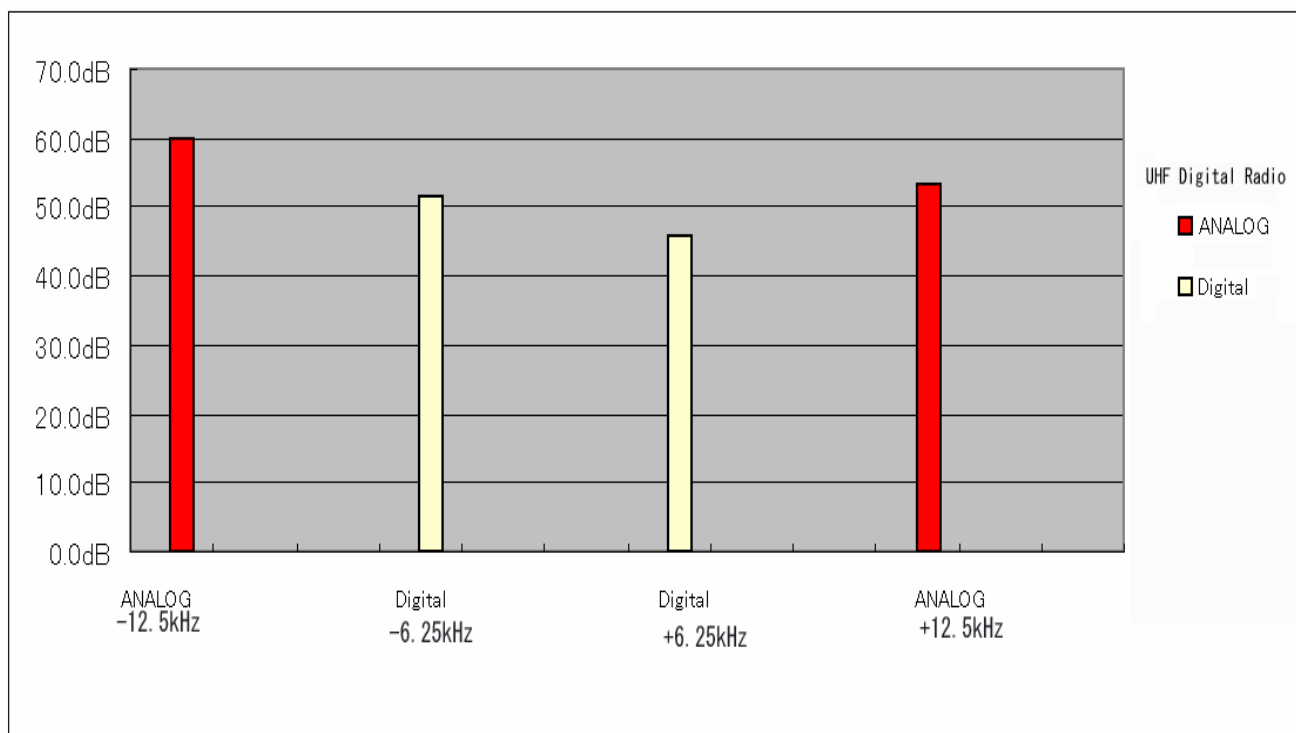
MODE	ANALOG	Digital	Digital	ANALOG
Δ freq	-12.5kHz	-7.5kHz	7.5kHz	12.5kHz
Digital Radio	55.8dB	61.5dB	59.0dB	58.1dB
Measurement Method	TIA-603-B	TIA-102.CAAA-B		TIA-603-B
Class B (TIA-603-B)	40dB	-	-	40dB

*Transmission rate and modulation is different from TIA-102.CAAA-B

UHF Adjacent Channel Rejection - 6.25kHz Channels

The following charts show 6.25kHz adjacent channel rejection in digital mode operation*. This performance in digital operation exceeds the standard value of a Class B radio in analog operation at 12.5kHz. Icom intends to improve this performance further (compared to 12.5kHz analog mode) in the near future. This whitepaper will be revised to reflect any new data at that time.

UHF Analog vs. Digital Adjacent Channel Rejection

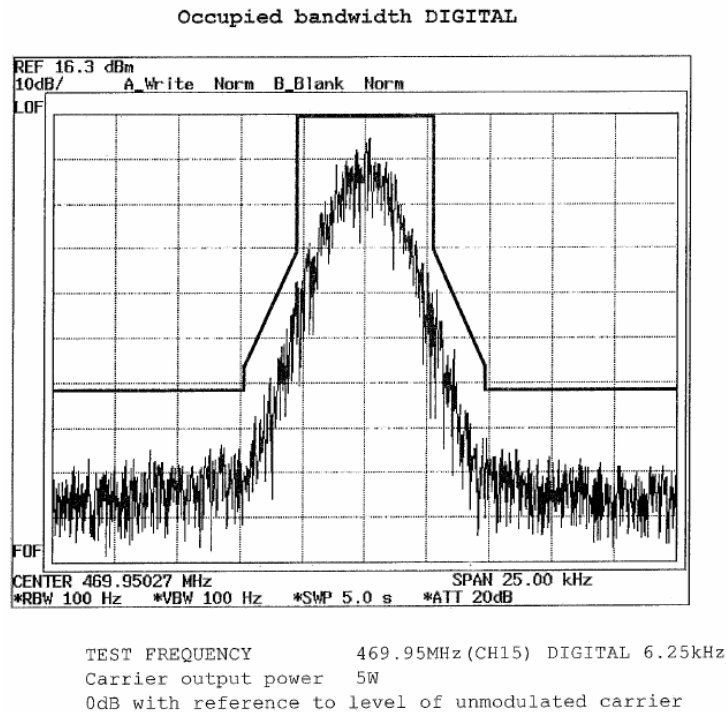


MODE	ANALOG	Digital	Digital	ANALOG
Δ freq	-12.5kHz	-6.25kHz	6.25kHz	12.5kHz
Digital Radio	59.9dB	51.6dB	45.9dB	53.4dB
Measurement Method	TIA-603-B	TIA-102.CAAA-B		TIA-603-B
Class B (TIA-603-B)	40dB	-	-	40dB

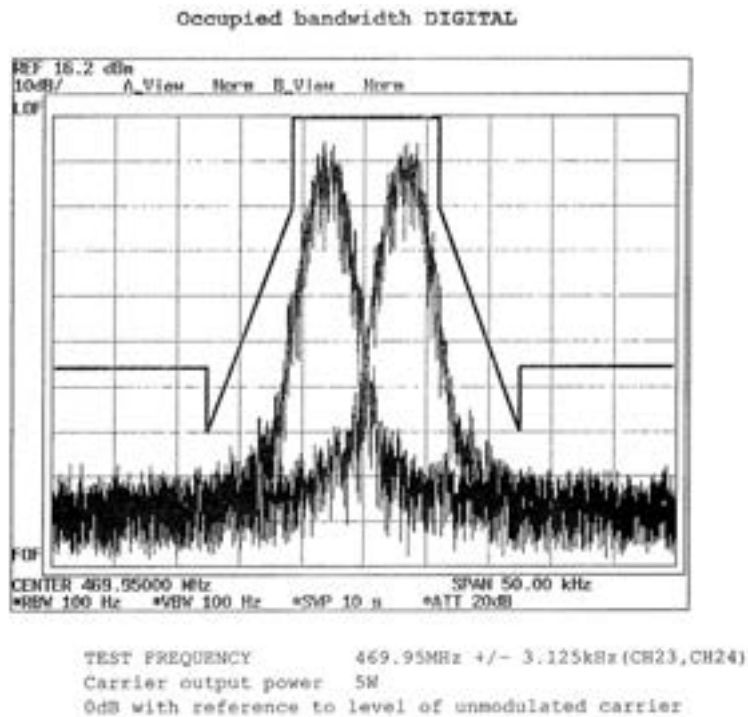
*Transmission rate and modulation is different from TIA-102.CAAA-B

Appendix B: Emission Masks

a. 6.25kHz Emission Mask



b. 12.5kHz Emission Mask



Appendix C: Minimize Potential Interference

According to FCC CFR 90.403 (e), “Licensees shall take reasonable precautions to avoid causing harmful interference. This includes monitoring the transmitting frequency for communications in progress and such other measures as may be necessary to *minimize the potential for causing interference.*”

The F3061/F4061 monitors both the operating and adjacent channels. It looks up and down 6.25kHz in UHF and 7.5kHz in VHF and prevents transmission when another analog or digital signal is present. This “Busy Channel Lockout” feature in the original release version of the F3061/F4061 is the primary method of preventing interference in co-channel operation.

Generally under most conditions, the busy channel lockout feature prevents the F3061/F4061 (when operating on a 6.25kHz channel) from interfering with incumbents operating on a 6.25, 12.5 or 25kHz adjacent or on-frequency channel.

Conversely, the F3061/F4061 when operating in the 12.5, 25kHz analog mode with busy channel lockout enabled will not interfere with an F3061/F4061 operating on a 6.25kHz channel on an adjacent or on-frequency channel.

Please refer to the test result tables below for specific data.

INITIAL PRODUCT RELEASE VERSION - ICOM INTENDS TO OBSERVE MARKET REACTION TO THIS METHOD AND EVALUATE ACTUAL OPERATION IN THE FIELD. ICOM WILL WORK WITH INDUSTRY ASSOCIATIONS, REGULATORS, AND FREQUENCY COORDINATORS TO FINE TUNE THIS OPERATION. ICOM MAY CHANGE THE DESIGN OF THIS PROTECTION CIRCUIT IN THE FUTURE, OR EMPLOY OTHER TECHNICAL METHODS TO PREVENT INTERFERENCE AND ACCOMPLISH THE MONITOR FUNCTION AS A RESULT OF THIS EVALUATION PROCESS.

Here is an illustrative example of the Busy Channel Lockout feature operation.

VHF Test Results

Freq Steps of Radio "A" in kHz	157.000000 (0 offset)				157.007500 (7.5 offset)			
Sig Strength	Weak Signal		Strong Signal		Weak Signal		Strong Signal	
No Modulation / Full Voice Modulation	Dead Carrier	Fully Modulated Carrier	Dead Carrier	Fully Modulated Carrier	Dead Carrier	Fully Modulated Carrier	Dead Carrier	Fully Modulated Carrier
Radio "B" Bandwidth								
25 kHz	AB	AB	AB	AB	---	---	A	A
12.5 kHz	AB	AB	AB	AB	---	---	A	A
6.25 kHz	AB	AB	AB	AB	---	---	AB	AB

A = "A" radio "busys" out

B = "B" radio "busys" out

Weak Signal: 2 Radios 3 Meters apart without antenna, 1Watt

Strong Signal: 2 Radios 3 Meters apart with antenna, 1Watt

"B" Radio ALWAYS at 157.00000

"A" Radio Starts at 157.00000 moves to 157.007500

"A" Radio always in 6.25 mode

UHF Test Results

Freq Steps of Radio "A" in kHz	460.000000 (0 offset)				460.00625 (6.25 offset)			
Sig Strength	Weak Signal		Strong Signal		Weak Signal		Strong Signal	
No Modulation / Full Voice Modulation	Dead Carrier	Fully Modulated Carrier	Dead Carrier	Fully Modulated Carrier	Dead Carrier	Fully Modulated Carrier	Dead Carrier	Fully Modulated Carrier
Radio "B" Bandwidth								
25 kHz	AB	AB	AB	AB	---	---	AB	AB
12.5 kHz	AB	AB	AB	AB	---	---	AB	AB
6.25 kHz	AB	AB	AB	AB	---	---	AB	AB

A = "A" radio "busys" out

B = "B" radio "busys" out

Weak Signal: 2 Radios 3 Meters apart without antenna

Strong Signal: 2 Radios 3 Meters apart with antenna

"B" Radio ALWAYS at 460.00000

"A" Radio Starts at 460.00000 moves up to 460.00625 (6.25 kHz offset)

"A" Radio always in 6.25 mode

No interference when radio "A" is more than 12.5 kHz away from radio "B" under any conditions

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NEWS

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Internet: <http://www.fcc.gov>
TTY: 1-888-835-5322

This is an unofficial announcement of Commission action. Release of the full text of a Commission order constitutes official action.
See *MCI v. FCC*, 515 F.2d 585 (D.C. Cir. 1974).

FOR IMMEDIATE RELEASE:
March 22, 2007

NEWS MEDIA CONTACT:
Chelsea Fallon: (202) 418-7991

FCC ADDRESSES RULES FOR PRIVATE LAND MOBILE RADIO SYSTEMS TO TRANSITION TO 6.25 kHz NARROWBAND TECHNOLOGY

Washington, D.C. –Today, the Federal Communications Commission (FCC) adopted a Third Report and Order (Order) that declines, for now, to establish a fixed date for private land mobile radio (PLMR) systems in the 150-174 MHz and 421-512 MHz bands to transition to 6.25 kHz narrowband technology, but strongly urges licensees to consider migrating directly to 6.25 kHz technology rather than first adopting 12.5 kHz technology and later migrating to 6.25 kHz technology. The Order also revises the implementation date of the 6.25 kHz equipment certification rules from January 1, 2005 to January 1, 2011.

In today's Order, the FCC declined to establish, at the present time, a fixed date for PLMR systems to transition to 6.25 kHz narrowband technology. There are no accepted industry standards for 6.25 kHz technology, which would be a bar to interoperability. Further, 6.25 kHz technology is not mature enough to warrant setting a migration schedule. The FCC reiterated, however, that it will expeditiously establish a schedule for transition to 6.25 kHz narrowband technology once the technology matures to the point that sufficient equipment is available for testing.

The FCC also decided in today's Order to change the date for the implementation of the 6.25 kHz equipment certification rules from January 1, 2005 to January 1, 2011, but strongly urges licensees to consider migrating directly to 6.25 kHz technology by January 1, 2013 rather than first adopting 12.5 kHz technology and later migrating to 6.25 kHz technology. Deferring the implementation date permits manufacturers to develop and test equipment after the expected finalization of 6.25 kHz standards in the near future.

Action by the Commission on March 22, 2007, by Third Report and Order (FCC 07-xxx).

For additional information, contact Scot Stone at (202) 418-0638 or Scot.Stone@fcc.gov, or Thomas Eng at (202) 418-0019 or Thomas.Eng@fcc.gov.

WT Docket No. 99-87.

– FCC –

News and other information about the Federal Communications Commission
is available at www.fcc.gov.

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

In the Matter of)	
)	
Implementation of Sections 309(j))	WT Docket No. 99-87
and 337 of the Communications)	
Act of 1934 as Amended)	
)	
Promotion of Spectrum Efficient)	RM-9332
Technologies on Certain Part 90)	
Frequencies)	

THIRD REPORT AND ORDER

Adopted: March 22, 2007

Released: March 26, 2007

By the Commission:

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I. INTRODUCTION AND EXECUTIVE SUMMARY

1. In the *Second Report and Order and Second Further Notice of Proposed Rule Making (Second Report and Order and Second Further Notice, respectively)* in this proceeding,¹ the Commission sought comment on requiring certain private land mobile radio (PLMR) licensees to transition to 6.25 kHz technology. In the *Third Memorandum Opinion and Order, Third Further Notice of Proposed Rule Making and Order (Third MO&O, Third Further Notice, and Order, respectively)* in this proceeding,² the Commission sought comment on a proposal³ to defer or eliminate the requirement in Sections 90.203(j)(4)-(5) of the Commission's Rules⁴ that certain applications for equipment authorizations received on or after January 1, 2005, must specify 6.25 kHz capability, and stayed the January 1, 2005, compliance date. This *Third Report and Order* addresses the comments and reply comments received in response to the *Second Further Notice* and the *Third Further Notice*.

2. The major decisions in the *Third Report and Order* are as follows:

- We decline to establish a fixed date for users to transition to 6.25 kHz technology.
- We change the implementation date for 6.25 kHz equipment capability as specified in Sections 90.203(j)(4)-(5) of the Rules, from January 1, 2005, to January 1, 2011.

II. BACKGROUND

3. In the *Refarming* proceeding in 1995, the Commission adopted rule changes to promote the efficient use of the PLMR service and facilitate the introduction of advanced technologies.⁵ To promote the transition to a more efficient narrowband channel plan, the Commission adopted certain market-based incentives in the PLMR service, by providing, *inter alia*, that "only increasingly efficient equipment" would be type certified.⁶ Accordingly, since February 14, 1997, the Commission has certified equipment employing 25 kHz channel bandwidth only if it was also capable of operating on 12.5 kHz or narrower channels, or with the equivalent efficiency.⁷ The *Refarming* rules also provided that applications for equipment certification received after January 1, 2005, would be granted only if the

¹ 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). The *Second Report and Order and Second Further Notice* was published in the Federal Register on July 17, 2003. 68 Fed. Reg. 42296, 42337 (2003).

² 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). The *Third MO&O and Third Further Notice and Order* was published in the Federal Register on June 15, 2004. 69 Fed. Reg. 34666, 34669 (2004).

³ Joint Petition of E.F. Johnson Company, Kenwood U.S.A. (Kenwood) and Motorola, Inc. (Motorola) to Defer Enforcement of Section 90.203(j)(5) of the Commission's Rules, WT Docket No. 99-87, RM-9332 (filed July 14, 2004) (Petition to Defer).

⁴ 47 C.F.R. § 90.203(j)(4)-(5).

⁵ See 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, 10077 ¶ 1 (1995) (*Refarming Report and Order*).

⁶ *Id.* at 10081 ¶ 7.

⁷ *Id.* at 10099-100 ¶¶ 38-40; 47 C.F.R. § 90.203(j)(2).

equipment is either capable of operating on 6.25 kHz or narrower channels, or has equivalent efficiency.⁸ The Commission did not set a date after which it would no longer approve equipment with a wideband (25 kHz) mode, or after which such equipment could no longer be manufactured or used.⁹ It believed that the mandate was unneeded because, as systems reached the end of their service life and new radios were needed, users would migrate to the narrower bandwidth multi-mode radios in order to avoid the adjacent channel interference that could occur from systems using the adjacent narrowband channels.¹⁰

4. In 2003, the Commission released the *Second Report and Order and Second Further Notice*. It determined that because the existing rules failed to provide adequate incentive to realize the Commission's spectrum efficiency goals in these bands, stronger measures would be required to bring about a timely transition to narrowband technology.¹¹ Specifically, the *Second Report and Order*: (1) prohibited any applications for new systems using 25 kHz channels, effective January 13, 2004;¹² (2) prohibited any modification applications that expand the authorized contour of an existing station if the bandwidth for transmissions specified in the modification application is greater than 12.5 kHz, effective January 13, 2004;¹³ (3) prohibited the certification of any 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, 2005; (4) prohibited the manufacture and importation of any 150-174 MHz or 421-512 MHz band equipment that can operate on a 25 kHz bandwidth beginning January 1, 2008; and (5) imposed deadlines of January 1, 2013, for licensees in the Industrial/Business Radio Pool and January 1, 2018, for licensees in the Public Safety Radio Pool to migrate to 12.5 kHz technology in the 150-174 MHz and 421-512 MHz bands.¹⁴

5. In the *Second Further Notice*, the Commission sought comment on whether measures similar to those adopted in the *Second Report and Order* to encourage the migration to 12.5 kHz narrowband technology should also be applied to facilitate migration to 6.25 kHz technology.¹⁵ Noting that 12.5 kHz technology was a transitional standard to facilitate migration to 6.25 kHz technology, and in light of the measures adopted in the *Second Report and Order*, the Commission tentatively concluded that similar measures would facilitate migration to 6.25 kHz technology.¹⁶ It also sought comment on a date or dates by which licensees must migrate to 6.25 kHz technology.¹⁷

6. In 2004, the Commission released the *Third MO&O, Third Further Notice, and Order*. In response to eighteen petitions for reconsideration of the rules adopted in the *Second Report and Order*, the Commission made the following decisions in the *Third MO&O and Order*:

⁸ See 47 C.F.R. § 90.203(j)(4)-(5) (2002).

⁹ See *Refarming Report and Order*, 10 FCC Rcd at 10100 ¶ 40.

¹⁰ *Id.*

¹¹ *Second Report and Order*, 18 FCC Rcd at 3038 ¶ 12.

¹² By *Order* released December 3, 2003, the Commission determined that good cause had been shown to stay the January 13, 2004 date pending Commission consideration of the petitions for reconsideration of the *Second Report and Order*. 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, *Order*, WT Docket No. 99-87, RM-9332, 18 FCC Rcd 25491 (2003).

¹³ The Commission also stayed this January 13, 2004 date. *Id.*

¹⁴ *Second Report and Order*, 18 FCC Rcd at 3038 ¶ 12.

¹⁵ *Second Further Notice*, 18 FCC Rcd at 3045 ¶ 27.

¹⁶ *Id.* (citing *Refarming Report and Order*, 10 FCC Rcd at 10095 ¶ 28).

¹⁷ *Id.*

- It 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 the narrowband equivalent of one voice channel per 12.5 kHz of channel bandwidth or 4800 bits per second per 6.25 kHz if the bandwidth for transmissions specified in the modification application is greater than 12.5 kHz.
- It revised the interim dates established in the *Second Report and Order* as follows:
 - Applications for new operations using 25 kHz channels will be accepted until January 1, 2011. Thereafter, applications for new operations using a bandwidth greater than 12.5 kHz will be accepted only to the extent that the equipment meets the spectrum efficiency standard of one voice channel per 12.5 kHz of channel bandwidth or 4800 bits per second per 6.25 kHz.
 - Applications for modification of operations that expand the authorized contour of an existing station using 25 kHz channels will be accepted until January 1, 2011. Thereafter, such applications that expand the authorized contour of an existing station will be accepted only to the extent that the equipment meets the spectrum efficiency standard of one voice channel per 12.5 kHz of channel bandwidth or 4800 bits per second per 6.25 kHz if the bandwidth for transmissions specified in the modification application is greater than 12.5 kHz.
 - Manufacture and importation of any 150-174 MHz and 421-512 MHz band equipment operating on a channel bandwidth up to 25 kHz will be permitted until January 1, 2011. Thereafter, manufacture and importation of any 150-174 MHz and 421-512 MHz band equipment operating on a channel bandwidth greater than 12.5 kHz will be accepted only to the extent that the equipment meets the spectrum efficiency standard of one voice channel per 12.5 kHz of channel bandwidth or 4800 bits per second per 6.25 kHz.
- It revised the Commission's Rules to permit applications for equipment certification received on or after January 1, 2005, operating with a 25 kHz bandwidth, to the extent that the equipment meets the spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth or 4800 bits per second per 6.25 kHz. However, it stayed the requirement in Sections 90.203(j)(4)-(5) that applications for equipment certification received on or after January 1, 2005, will be granted only if the equipment either (1) is capable of operating on 6.25 kHz channels, or (2) the equipment meets a narrowband efficiency standard, *i.e.*, one channel per 6.25 kHz or 4800 bits per second per 6.25 kHz.¹⁸

The Commission received no petitions for reconsideration of the *Third MO&O* and *Order*.

7. In the *Third Further Notice*, the Commission sought comment on a proposal to defer or eliminate the January 1, 2005, date in Sections 90.203(j)(4)-(5).¹⁹ Specifically, it asked whether the 6.25 kHz equipment certification rules would place onerous burdens on manufacturers and jeopardize the promotion of interoperability between users in the absence of a 6.25 kHz equivalent efficiency standard.²⁰

¹⁸ *Third MO&O*, 19 FCC Rcd at 25047 ¶ 2.

¹⁹ *Third Further Notice*, 19 FCC Rcd at 25062 ¶ 40.

²⁰ *Id.*; see also Petition to Defer at 2.

Additionally, it sought comment on equipment that is specifically manufactured to utilize 6.25 kHz channel bandwidth as opposed to wider bandwidth equipment capable of operating with an equivalent efficiency of 6.25 kHz.²¹ Finally, the Commission sought comment on whether 6.25 kHz bandwidth equipment versus wider bandwidth equipment with an equivalent efficiency of 6.25 kHz affects interoperability.²² The Commission also stated that it would defer its decision on the broader issues raised in the *Second Further Notice* regarding migration to 6.25 kHz technology until it compiled a record in response to the *Third Further Notice*.²³

III. DISCUSSION

A. User Migration to 6.25 kHz Technology

8. As noted above, the Commission sought comment in the *Second Further Notice* on whether measures similar to those adopted in the *Second Report and Order* to encourage the migration to 12.5 kHz narrowband technology should also be applied to encourage migration to 6.25 kHz technology. The comments to the *Second Further Notice* unanimously oppose a mandatory migration requirement to 6.25 kHz technology as “premature and inappropriate.”²⁴ Several comments state that a mandatory conversion to 6.25 kHz would have significant technological hurdles to overcome, would add unnecessary confusion during the transition to 12.5 kHz, and would actually delay deployment of spectrum efficient technology.²⁵ Motorola, Inc. (Motorola) states that the Commission should permit market forces to shape the demand for 6.25 kHz.²⁶ It points out that while the Project 25²⁷ “Phase I” 12.5 kHz frequency division multiple access (FDMA)²⁸ standard is complete, development of a Project 25 “Phase II” 6.25 kHz FDMA standard is still in progress. Therefore, Motorola contends that any mandated changes at this time would be a waste of resources spent on developing a 12.5 kHz standard and would likely increase equipment costs.²⁹ Other comments suggest that market demand is not sufficient to spur the manufacture of 6.25 kHz equipment.³⁰ Existing time division multiple access (TDMA)³¹ technology

²¹ *Third Further Notice*, 19 FCC Rcd at 25062 ¶ 40.

²² *Id.*

²³ *Id.* at 25062 ¶ 41.

²⁴ See, e.g., Industrial Telecommunications Association (ITA) Comments to the *Second Further Notice* at 1, 5 (citing lack of availability of equipment); Private Wireless Mining Coalition Comments to the *Second Further Notice* at 5-6; Tait North America, Inc. Comments to the *Second Further Notice* at 4-5. We note that ITA subsequently consolidated its operations into the Enterprise Wireless Alliance (EWA). See Mark E. Crosby, *Letter*, 20 FCC Rcd 8552 (WTB PSCID 2005).

²⁵ See, e.g., Association of Public-Safety Communications Officials – International, Inc. (APCO) Comments to the *Second Further Notice* at 2; Land Mobile Communications Council (LMCC) Comments to the *Second Further Notice* at 2-3; ITA Comments to the *Second Further Notice* at 4.

²⁶ Motorola Comments to the *Second Further Notice* at 1.

²⁷ Project 25 is the standard for interoperable, digital, two-way wireless communications products and systems.

²⁸ FDMA refers to the method of allocating a discrete amount of frequency bandwidth to each user to permit many simultaneous conversations. See Harry Newton, *Newton’s Telecom Dictionary*, 327 (San Francisco: CMP Books, 2004).

²⁹ Motorola Comments to the *Second Further Notice* at 7.

³⁰ See ITA Comments to the *Second Further Notice* at 4-5; LMCC Reply Comments to the *Second Further Notice* at 4; Federal Law Enforcement Wireless Users Group *Ex Parte* Comments to the *Second Further Notice* at 6.

³¹ TDMA is used to allocate a discrete amount of frequency bandwidth to each user to permit many simultaneous conversations. However, each user is assigned a specific timeslot for transmission. See Harry Newton, *Newton’s Telecom Dictionary*, 814 (San Francisco: CMP Books, 2004).

provides 6.25 kHz equivalency over 12.5 kHz (2-slot) or 25 kHz (4-slot) bandwidths,³² and most federal agencies have established communications systems based on a 12.5 kHz standard.³³ Other comments state that a mandatory migration to 6.25 kHz narrowband is not an economically feasible or technologically viable option for high speed data transmissions,³⁴ “one-to-many” dispatch architecture via simulcast,³⁵ or encryption of voice and data.³⁶

9. Commenters to the *Third Further Notice* also oppose a mandatory migration requirement for 6.25 kHz technology. The National Public Safety Telecommunications Council (NPSTC) believes that a mandatory date for transitioning to 6.25 kHz would be counterproductive to the FCC’s objective to complete the transition to 12.5 kHz, because the 12.5 kHz transition presents significant operational and logistical challenges to public safety agencies.³⁷ NPSTC notes that a finite date mandating yet another transition raises the specter of more expense in a sector where equipment cycles are already lengthy.³⁸ Further, NPSTC urges the Commission not to mandate a transition to 6.25 kHz technology until operational issues such as interoperability capability are resolved.³⁹ Finally, NPSTC states that requiring 6.25 kHz spectrum efficiency without widespread availability, use, and acceptance of equipment would be counterproductive to the Commission’s objective.⁴⁰ Icom America, Inc. and Icom, Inc. (collectively, Icom) see little benefit in setting dates for user conversion to 6.25 kHz at this time, with mandatory conversion to 12.5 kHz taking place by 2013.⁴¹ Motorola and Kenwood USA Corporation (Kenwood) note that the Commission can defer reassessment of the development of 6.25 kHz technologies until early next decade, when the 12.5 kHz transition will be near completion.⁴²

10. Based on our review of the comments, we will not establish a specific migration plan to 6.25 kHz at this time. We note that the majority of commenters believe that adopting such a measure would be premature, and we conclude that more time is warranted to allow further development and field testing of the 6.25 kHz standard. It thus is not presently apparent what date would be most appropriate for requiring licensees to use radios that operate on 6.25 kHz channels or wider-band equipment that delivers equivalent efficiency.

11. 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. We will pay particular attention to progress made in the development of 6.25 kHz technology. 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. As discussed

³² APCO Comments to the *Second Further Notice* at 2.

³³ *Id.* at 3.

³⁴ LMCC Comments to the *Second Further Notice* at 5.

³⁵ APCO Comments to the *Second Further Notice* at 4.

³⁶ American Association of Railroads Comments to the *Second Further Notice* at 5.

³⁷ NPSTC Comments to the *Third Further Notice* at 3-4.

³⁸ *Id.* at 4.

³⁹ *Id.* at 6.

⁴⁰ *Id.* at 7.

⁴¹ Icom Comments to the *Third Further Notice* at 5; accord Motorola Comments to the *Third Further Notice* at 2.

⁴² Motorola Comments to the *Third Further Notice* at 3, Kenwood Comments to the *Third Further Notice* at 5, Motorola Reply Comments to the *Third Further Notice* at 3.

below, radios that operate on 6.25 kHz channels or wider-band equipment that delivers equivalent efficiency will be available before the January 1, 2013 date by which users must migrate to 12.5 kHz 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.

B. Implementation Date in Sections 90.203(j)(4)-(5)

12. As noted above, the Commission sought comment in the *Third Further Notice* on whether to defer or eliminate the requirement in Sections 90.203(j)(4)-(5) that applications for 150-174 MHz and 421-512 MHz equipment authorizations received on or after January 1, 2005, must specify 6.25 kHz capability. All commenters to the *Third Further Notice* oppose the January 1, 2005, implementation date. This date was stayed in the *Order*, and we see no value in retaining it in the rules, when, even now, there is no industry standard for 6.25 kHz equipment. As M/A-COM, Inc. (M/A-COM) notes, enforcing an equipment authorization cut-off now would place onerous burdens on manufacturers because they would be forced to produce interim technologies before the finalization of standards, simply to comply with this spectrum efficiency rule.⁴³ The finalization of standards afterward could require the development of new, compliant radio equipment at additional cost to the manufacturers and, ultimately, to consumers. We also agree with NPSTC that enforcing the deadline now without the widespread availability, use, and acceptance of equipment could impair the Commission's interoperability objectives, because interoperability among public safety users would suffer if non-standardized 6.25 kHz equipment were deployed prior to the emergence of an interoperability standard.⁴⁴

13. We disagree, however, with those parties, such as the Land Mobile Communications Council (LMCC), Kenwood, Motorola, and Enterprise Wireless Alliance (EWA), that argue that the requirement should be eliminated entirely,⁴⁵ and marketplace activities alone should influence introduction and adoption of 6.25 kHz technologies into equipment.⁴⁶ Motorola argues that, because the initial rules governing narrowbanding -- not certifying new 25 kHz radios after a date certain -- did not fully and rapidly achieve the Commission's first narrowband initiative, we should abandon that incentive altogether in the context of implementing 6.25 kHz narrowbanding.⁴⁷ However, the Commission never determined that the 25 kHz certification limitation was inherently ineffective. It said only that the certification limitation, alone, was not producing the desired result and that an additional -- not an alternative -- measure was necessary to timely implement narrowbanding to 12.5 kHz.⁴⁸ Thus it retained the certification limitation and added the additional provision that barred use of 25 kHz equipment after a date certain. Motorola, *et al.* have made no persuasive argument for eliminating the rule barring certification, after a date certain, of radios that do not meet a 6.25 kHz (or equivalent) efficiency standard and we decline to do so.

⁴³ M/A-COM Comments to the *Third Further Notice* at 1-2.

⁴⁴ NPSTC Comments to the *Third Further Notice* at 7.

⁴⁵ LMCC Comments to the *Third Further Notice* at 1; Kenwood Comments to the *Third Further Notice* at 7; Motorola Comments to the *Third Further Notice* at 1; EWA Comments to the *Third Further Notice* at 1.

⁴⁶ LMCC Comments to the *Third Further Notice* at 4; Comments to the *Third Further Notice* at 3; Motorola Comments to the *Third Further Notice* at 3; EWA Comments to the *Third Further Notice* at 5-6; Motorola Reply Comments to the *Third Further Notice* at 2.

⁴⁷ Petition for Reconsideration and Clarification of Motorola, Inc., WT Docket No. 99-87, RM-9332 (filed August 18, 2003) at 11.

⁴⁸ *Second Report and Order*, 18 FCC Rcd at 3038 ¶ 12.

14. We agree with Icom that mandating a 6.25 kHz efficiency standard will spur technological advances and provide choices for users.⁴⁹ Icom supports a date in the near future in order to ensure that users can choose between 12.5 kHz and 6.25 kHz equipment as the 12.5 kHz user transition date approaches.⁵⁰ We are concerned, however, that adoption of too early a date may not allow enough time for field testing of equipment once 6.25 kHz standards have been established. This would not further the public interest, because it could bring about the same circumstances that led the Commission to stay and reexamine the January 1, 2005, date.

15. LMCC supports an implementation date of January 1, 2015,⁵¹ which would bring the rule section into line with the new deadline of December 31, 2014, after which manufacturers may market, manufacture, and import only 6.25 kHz equipment or 12.5 kHz dual mode equipment in the 700 MHz band.⁵² LMCC argues that this would maximize economies of scale for equipment manufacturers.⁵³ Delaying the implementation date by ten years, however, appears both unnecessary and contrary to the purpose of this proceeding.

16. We conclude, based on the record in this proceeding, that January 1, 2011, is the most appropriate date to implement the requirement in Sections 90.203(j)(4)-(5) that certain applications for equipment authorizations specify 6.25 kHz capability. First, it is the same date as the interim deadline the Commission established in the *Third MO&O* prohibiting the manufacture or importation of 25 kHz equipment. Having these deadlines coincident will offer users a choice between 6.25 kHz and 12.5 kHz equipment well ahead of the 2013 deadline for migration to 12.5 kHz technology and increase economies of scale for equipment manufacturers. Availability of 6.25 kHz equipment before the 12.5 kHz migration deadline may encourage some users of wideband equipment to make one cost-saving transition directly to 6.25 kHz-capable equipment. Second, the date is in line with NPSTC's recommendation of implementing the rules five years after a 6.25 kHz interoperability standard has been defined and published by the Telecommunications Industry Association (TIA) and/or the American National Standards Institute (ANSI), which is expected to occur in the near future.⁵⁴

C. Other Issues

1. M/A-COM Proposals to Restructure the Bands Below 512 MHz and Convert Shared Channels to Exclusive Use Channels in the Bands Below 470 MHz

17. In its comments to the *Third Further Notice*, M/A-COM proposes two major changes to Part 90 of the Commission's Rules that it believes would promote efficiency and facilitate the deployment and use of 6.25 kHz equipment. First, M/A-COM suggests restructuring the bands below 512 MHz.⁵⁵ M/A-COM offers alternate-channel center plans in both the VHF and UHF bands,⁵⁶ which it contends

⁴⁹ Icom Reply Comments to the *Third Further Notice* at 4-5.

⁵⁰ Icom Comments to the *Third Further Notice* at 6.

⁵¹ LMCC Comments to the *Third Further Notice* at 5.

⁵² See The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communication Requirements Through the Year 2010, *Fifth Memorandum Opinion and Order, Sixth Report and Order, and Seventh Notice of Proposed Rule Making*, WT Docket No. 96-86, 20 FCC Rcd 831, 838 ¶ 13 (2005).

⁵³ LMCC Comments to the *Third Further Notice* at 5.

⁵⁴ NPSTC Comments to the *Third Further Notice* at 8; NPSTC Reply Comments to the *Third Further Notice* at 3.

⁵⁵ M/A-COM Comments to the *Third Further Notice* at 4-5.

⁵⁶ Petition for Reconsideration of the *Second Report and Order* filed by M/A-COM, Inc., WT Docket 99-87, RM-9332 (filed Aug. 18, 2003) at 14-17.

would yield more effective spectrum when the transition is made to more spectrum-efficient technology.⁵⁷ Second, M/A-COM suggests that converting shared channels to exclusive-use channels in the bands below 470 MHz would be an incentive for licensees to migrate to more efficient equipment as they become capacity-limited.⁵⁸ In making a case against the current shared environment, M/A-COM cites the *Second Report and Order*, where the Commission stated that licensees do not necessarily accrue the benefits of investment in narrowband technology because some may choose more efficient equipment while other licensees in the band may not.⁵⁹

18. Icom believes that a more comprehensive review of M/A-COM's suggestions is warranted, although it recognizes that this review is beyond the scope of the Commission's current inquiry.⁶⁰ NPSTC states that M/A-COM's suggestions present issues that overtake the question in the *Third Further Notice*.⁶¹ We agree and note that M/A-COM may pursue its proposals further by filing a petition for rulemaking. We also note that in the *Report and Order* in this proceeding, the Commission rejected a proposal to convert part of the 450-470 MHz band from shared channels to exclusive use channels.⁶² Motorola opposes M/A-COM's band restructuring recommendation on the basis that it would cause unnecessary disruption to the narrowbanding initiative, and Motorola recalls that the Commission considered and rejected similar band restructuring proposals in the *Refarming* proceeding.⁶³ Specifically, in 1995, *Refarming* commenters opposed a requirement to shift their frequencies to align with a proposed channelization plan,⁶⁴ and the Commission recognized that remaining on-channel was seen as critical to existing licensees.⁶⁵ In 1996, the Commission denied several petitions for reconsideration seeking a shift in VHF channelization and reaffirmed the channel plan adopted in the *Refarming Report and Order*.⁶⁶ Motorola believes that M/A-COM has presented no new arguments that would warrant reconsideration of these *Refarming* decisions.⁶⁷ To address Motorola's concern, any such petition for rulemaking should explain how circumstances have changed to warrant consideration of these proposals.

⁵⁷ M/A-COM Comments to the *Third Further Notice* at 4-5.

⁵⁸ *Id.* at 8.

⁵⁹ *Id.* Also see *Second Report and Order*, 18 FCC Rcd at 3039 ¶ 13. *But see* Motorola Reply Comments to the *Third Further Notice* at 4 (arguing that M/A-COM's proposal lacks sufficient detail to merit consideration at this time).

⁶⁰ Icom Reply Comments to the *Third Further Notice* at 7.

⁶¹ NPSTC Reply Comments to the *Third Further Notice* at 3-4.

⁶² 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; Establishment of Public Service Radio Pool in the Private Mobile Frequencies Below 800 MHz; Petition for Rule Making of the American Mobile Telecommunications Association, *Report and Order and Further Notice of Proposed Rule Making*, WT Docket No. 99-87, RM-9332, RM-9405, RM-9705, 15 FCC Rcd 22709, 22757-59 ¶¶ 104-07 (1999). The Commission concluded that it was not advisable to revisit the licensing scheme in light of commenters' concerns that the forced migration of incumbents would cause harmful disruptions in service as well as severe levels of interference. *Id.* at 22758-59 ¶¶ 106-07.

⁶³ Motorola *Third Further Notice* Reply Comments at 5; see *Refarming Report and Order*, 10 FCC Rcd at 10094 ¶ 26; see also Replacement of Part 90 by Part 90 by Part 88 to Revise the Private Land Mobile Radio Services and Modify the Policies Governing Them, *Memorandum Opinion and Order*, PR Docket No. 92-235, 11 FCC Rcd 17676, 17682 ¶ 11 (1996) (*Refarming MO&O*).

⁶⁴ See *Refarming Report and Order*, 10 FCC Rcd at 10088 ¶¶ 17-18.

⁶⁵ *Id.* at 10094 ¶ 26.

⁶⁶ See *Refarming MO&O*, 11 FCC Rcd at 17682 ¶ 11.

⁶⁷ Motorola *Third Further Notice* Reply Comments at 5.

2. Effects of 12.5 kHz Interim Transition Date on Public Safety Users

19. NPSTC embraces the Commission mandate for conversion to 12.5 kHz technology by January 1, 2013.⁶⁸ However, NPSTC anticipates that the requirements of the January 1, 2011, interim transitional date, which the Commission adopted in the *Third MO&O*, present significant operational and logistical challenges to public safety agencies.⁶⁹ After January 1, 2011, neither a modification to expand the contour of an existing station nor the manufacture or importation of equipment may take place unless the equipment comports with 12.5 kHz technology.⁷⁰ NPSTC notes that it is not unusual for public safety agencies to expand or change the geographic areas for which they are responsible.⁷¹ Such changes would not be permitted after January 1, 2011, for systems that operate exclusively at 25 kHz. Additionally, if an agency's 25 kHz bandwidth-only equipment is damaged, lost, or incapable of repair, NPSTC is concerned that replacement equipment may not be available after January 1, 2011.⁷² NPSTC finds it unreasonable that unless it obtains a waiver of the Commission's rules, an agency cannot expand its contour or replace its 25 kHz equipment after January 1, 2011, which is two years ahead of the firm date for 12.5 kHz technology.⁷³

20. In the *Third MO&O*, the Commission addressed concerns regarding interim dates, including concerns about modifications and replacement equipment, by delaying the interim dates to January 1, 2011.⁷⁴ However, the Commission emphasized that the purpose of interim deadlines is to encourage licensees to begin planning and implementing migration to narrowband technology well before January 1, 2013.⁷⁵ NPSTC has presented no new reason to revisit the 12.5 kHz migration schedule. We continue to believe that licensees will have ample opportunity and incentive to convert to 12.5 kHz technology before or during the two-year interim period without jeopardizing interoperability.

IV. PROCEDURAL MATTERS

A. Regulatory Flexibility Act Analysis

21. As required by Section 603 of the Regulatory Flexibility Act (RFA), 5 U.S.C. § 604, the Commission has prepared a Final Regulatory Flexibility Analysis of the possible impact of the rule changes contained in this *Third Report and Order* on small entities. The Final Regulatory Flexibility Act analysis is set forth in Appendix C, *infra*. The Commission's Consumer Information Bureau, Reference Information Center, will send a copy of this *Third Report and Order*, including the Final Regulatory Flexibility Act Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

B. Paperwork Reduction Act of 1995 Analysis

22. 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

⁶⁸ NPSTC Comments to the *Third Further Notice* at 4.

⁶⁹ *Id.* at 4-5.

⁷⁰ See 47 C.F.R. §§ 90.203(j)(11), 90.209(b)(6)(ii) (effective July 15, 2005).

⁷¹ NPSTC Comments to the *Third Further Notice* at 5.

⁷² *Id.*

⁷³ *Id.* at 6.

⁷⁴ *Third MO&O*, 19 FCC Rcd at 25053-56 ¶¶ 15-23.

⁷⁵ *Id.* at 25055 ¶ 22.

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).

C. Congressional Review Act Analysis

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

D. Further Information

24. For further information concerning this *Third Report and Order*, contact Mel Spann, Mobility Division, Wireless Telecommunications Bureau, Federal Communications Commission, Washington, D.C. 20554, at (202) 418-0680, TTY (202) 418-7233, via e-mail at Melvin.Spann@fcc.gov, or via U.S. Mail at Federal Communications Commission, Wireless Telecommunications Bureau, 445 12th Street, S.W., Washington, D.C. 20554.

25. Alternative formats (computer diskette, large print, audio cassette, and Braille) are available to persons with disabilities by sending an e-mail to FCC504@fcc.gov or calling the Consumer and Governmental Affairs Bureau at (202) 418-0530, TTY (202) 418-0432. This *Third Report and Order* can be downloaded at <http://wireless.fcc.gov/releases.html#orders>.

V. ORDERING CLAUSES

26. Accordingly, pursuant to Sections 1, 2, 4(i), 301, 302, and 303 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 151, 152, 154(i), 301, 302, 303, and Sections 1.421 and 1.425 of the Commission’s Rules, 47 C.F.R. §§ 1.421, 1.425, IT IS ORDERED that the *Third Report and Order* is hereby ADOPTED.

27. IT IS FURTHER ORDERED that Part 90 of the Commission’s Rules IS AMENDED as set forth in Appendix B, and that these Rules shall be effective [30 days after publication in the Federal Register].

28. IT IS FURTHER ORDERED that the stay of the deadline in 47 C.F.R. § 90.203(j)(4) and (j)(5), see FCC 04-292, 69 Fed. Reg. 34666, SHALL EXPIRE [30 days after publication in the Federal Register].

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

30. IT IS FURTHER ORDERED that this proceeding is TERMINATED.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

Appendix A**Petition to Defer and Comments****Petition to Defer**

EF Johnson Company, Kenwood U.S.A. Corporation (Kenwood), and Motorola, Inc. (Motorola)

Comments to the *Second Further Notice*

Association of American Railroads (AAR)

Association of Public-Safety Communications Officials–International, Inc. (APCO), International Association of Fire Chiefs, Inc. and the International Municipal Signal Association (IAFC/IMSA), International Association of Chiefs of Police (IACP), Major Cities Chiefs Association (MCCA), National Sheriffs' Association (NSA), Major County Sheriffs' Association (MCSA), and National Public Safety Telecommunications Council (NPSTC) (collectively, APCO et al.)

Federal Law Enforcement Wireless Users Group (FLEWUG)

Industrial Telecommunications Association (ITA)

Land Mobile Communications Council (LMCC)

Motorola

Private Wireless Mining Coalition (Coalition)

Tait North America, Inc. (TAIT)

Reply Comments to the *Second Further Notice*

LMCC

Comments to the *Third Further Notice*

Enterprise Wireless Alliance (EWA)

Icom America, Inc. and Icom, Inc. (Icom)

Kenwood U.S.A. Corporation, Communications Division (Kenwood)

LMCC

M/A-COM

Motorola

National Public Safety Telecommunications Council (NPSTC)

Reply Comments to the *Third Further Notice*

Icom

Motorola

NPSTC

Other Relevant Filings:

NPSTC Letter to Michael Wilhelm, Chief, Public Safety and Critical Infrastructure, Wireless Telecommunications Bureau, dated Sept. 19, 2005

Appendix B**Final Rules**

Part 90 of Title 47 of the Code of Federal Regulations is amended as follows:

PART 90—PRIVATE LAND MOBILE RADIO SERVICES

1. The authority citation for Part 90 continues to read as follows:

AUTHORITY: Sections 4(i), 11, 303(g), 303(r), and 332(c)(7) of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 161, 303(g), 303(r), 332(c)(7).

2. Section 90.203 is amended by removing paragraphs (j)(6), (j)(6)(i), (j)(6)(ii), and (j)(6)(iii); redesignating paragraphs (j)(7)-(11) as (j)(6)-(10); and revising paragraphs (j)(4) and (j)(5) to read as follows:

§ 90.203 Certification required.

* * * * *

(j) * * * * *

- (4) Applications for part 90 certification of transmitters designed to operate on frequencies in the 150.8-162.0125 MHz, 173.2-173.4 MHz, and/or 421-512 MHz bands, received on or after January 1, 2011, except for hand-held transmitters with an output power of two watts or less, will only be granted for equipment with the following channel bandwidths:

* * * * *

- (5) Applications for part 90 certification of transmitters designed to operate on frequencies in the 150.8-162.0125 MHz, 173.2-173.4 MHz, and/or 421-512 MHz bands, received on or after January 1, 2011, must include a certification that the equipment meets a spectrum efficiency standard of one voice channel per 6.25 kHz of channel bandwidth. Additionally, if the equipment is capable of transmitting data, has transmitter output power greater than 500 mW, and has a channel bandwidth of more than 6.25 kHz, the equipment must be capable of supporting a minimum data rate of 4800 bits per second per 6.25 kHz of channel bandwidth.

* * * * *

Appendix C

Final Regulatory Flexibility Analysis

1. As required by the Regulatory Flexibility Act (RFA),¹ an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Third Memorandum Opinion and Order and Third Further Notice of Proposed Rule Making and Order (Third MO&O and Third Further Notice)*² in WT Docket 99-87. The Commission sought written public comment on the proposals in the *Third Further Notice*. In view of the fact that we have adopted further rule amendments in this *Third Report and Order*, we have included this Final Regulatory Flexibility Analysis (FRFA). This Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.³

I. Reason for, and Objectives of, the *Third Report and Order*

2. This *Third Report and Order* is needed to address comments in response to the *Third Further Notice of Proposed Rule Making*⁴ in WT Docket 99-87 concerning a contemplated mandatory transition to 6.25 kHz technology for Private Land Mobile Radio (PLMR) users. In this *Third Report and Order*, we change the implementation date of 47 C.F.R. § 90.203(j)(4)-(5) from January 1, 2005, to January 1, 2011. The rule change reduces burdens on equipment manufacturers and furthers the Commission's objectives to encourage the development and use of increasingly spectrally efficient technology. Once the rule change becomes effective, applications for equipment certification received on or after January 1, 2011, will be granted only if the equipment either (1) is capable of operating on 6.25 kHz channels, or (2) meets a narrowband efficiency standard, *i.e.*, one channel per 6.25 kHz (voice) or 4800 bits per second per 6.25 kHz (data).

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

3. No comments or reply comments were filed in direct response to the IRFA. The Commission has, however, reviewed the general comments that may impact small businesses. Much of the potential impact on small businesses arose from the previous requirement that applications for equipment certification received on or after January 1, 2005, will be granted only if the equipment either (1) is capable of operating on 6.25 kHz channels, or (2) meets a narrowband efficiency standard, *i.e.*, one channel per 6.25 kHz (voice) or 4800 bits per second per 6.25 kHz (data). The burdens and hardships associated with equipment manufacturers meeting this requirement were cited in opposition to this requirement.

¹ See U.S.C. § 603. The RFA, *see* 5 U.S.C. § § 601-612, has been amended by the Contract With America Advancement Act of 1996, Pub. L. No. 104-121, 110 Stat. 847 (1996) (CWAAA). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

² 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 and Third Further Notice of Proposed Rulemaking and Order*, WT Docket No. 99-87, RM-9332, 19 FCC Rcd 25045 (2004). The *Third MO&O and Third Further Notice and Order* was published in the Federal Register on June 15, 2004. 69 Fed. Reg. 34666, 34669 (2004).

³ See 5 U.S.C. § 604.

⁴ 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 Rulemaking and Order*, WT Docket No. 99-87, RM-9332, 18 FCC Rcd 3034 (2003). The *Second Report and Order and Second Further Notice* was published in the Federal Register on July 17, 2003. 68 Fed. Reg. 42296, 42337 (2003).

III. Description and Estimate of the Number of Small Entities to Which the Rules Apply

4. The RFA directs agencies to provide a description of and, where feasible, an estimate of the number of small entities that may be affected by the rules adopted. The RFA generally defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small governmental jurisdiction.”⁵ In addition, the term “small business” has the same meaning as the term “small business concern” under the Small Business Act.⁶ A small business concern is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).⁷ Nationwide, there are a total of approximately 22.4 million small businesses, according to SBA data.⁸ A “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”⁹ Nationwide, as of 2002, there were approximately 1.6 million small organizations.¹⁰ The term “small governmental jurisdiction” is defined generally as “governments of cities, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”¹¹ Census Bureau data for 2002 indicate that there were 87,525 local governmental jurisdictions in the United States.¹² We estimate that, of this total, 84,377 entities were “small governmental jurisdictions.”¹³ Thus, we estimate that most governmental jurisdictions are small.

5. The rule change effectuated by this *Third Report and Order* applies to manufacturers of radio equipment designed to operate on private land mobile frequencies in the 150-174 MHz and 421-512 MHz bands. The rule change and decisions herein also have a nominal, merely indirect application to users of Public Safety Radio Pool services and private radio licensees that are regulated under Part 90 of the Commission’s rules.

6. *Equipment Manufacturers.* We anticipate that at least six radio equipment manufacturers will be affected by our decisions in this proceeding. The Census Bureau defines this category as follows: “This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.”¹⁴ The SBA has developed a small business size standard for Radio and Television

⁵ See 5 U.S.C. § 601(6).

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

⁷ Small Business Act, 5 U.S.C. § 632 (1996).

⁸ See SBA, Programs and Services, SBA Pamphlet No. CO-0028, at page 40 (July 2002).

⁹ 5 U.S.C. § 601(4).

¹⁰ Independent Sector, *The New Nonprofit Almanac & Desk Reference* (2002).

¹¹ 5 U.S.C. § 601(5).

¹² U.S. Census Bureau, *Statistical Abstract of the United States: 2006*, Section 8, page 272, Table 415.

¹³ We assume that the villages, school districts, and special districts are small, and total 48,558. See U.S. Census Bureau, *Statistical Abstract of the United States: 2006*, section 8, page 273, Table 417. For 2002, Census Bureau data indicate that the total number of county, municipal, and township governments nationwide was 38,967, of which 35,819 were small. *Id.*

¹⁴ U.S. Census Bureau, 2002 NAICS Definitions, “334220 Radio and Television Broadcasting and Wireless (continued....)

Broadcasting and Wireless Communications Equipment Manufacturing, which is: all such firms having 750 or fewer employees.¹⁵ According to Census Bureau data for 2002, there were a total of 1,041 establishments in this category that operated for the entire year.¹⁶ Of this total, 1,010 had employment of under 500, and an additional 13 had employment of 500 to 999.¹⁷ Thus, under this size standard, the majority of firms can be considered small.

7. *Public safety services and Governmental entities.* Public safety radio services include police, fire, local governments, forestry conservation, highway maintenance, and emergency medical services.¹⁸ The SBA rules contain a definition for small radiotelephone (wireless) companies that encompass business entities engaged in radiotelephone communications employing no more than 1,500 persons.¹⁹ There are a total of approximately 127,540 licensees within these services. Governmental entities as well as private businesses comprise the licensees for these services. The RFA also includes small governmental entities as a part of the regulatory flexibility analysis.²⁰ As noted, under the RFA, the term “small governmental jurisdiction” is defined generally as “governments of cities, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”²¹ Census Bureau data for 2002 indicate that there were 87,525 local governmental jurisdictions in the United States.²² We estimate that, of this total, 84,377 entities were “small governmental jurisdictions.”²³ Thus,

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Communications Equipment Manufacturing”; <http://www.census.gov/epcd/naics02/def/NDEF334.HTM#N3342>.

¹⁵ 13 C.F.R. § 121.201, NAICS code 334220.

¹⁶ U.S. Census Bureau, American FactFinder, 2002 Economic Census, Industry Series, Industry Statistics by Employment Size, NAICS code 334220 (released May 26, 2005); <http://factfinder.census.gov>. The number of “establishments” is a less helpful indicator of small business prevalence in this context than would be the number of “firms” or “companies,” because the latter take into account the concept of common ownership or control. Any single physical location for an entity is an establishment, even though that location may be owned by a different establishment. Thus, the numbers given may reflect inflated numbers of businesses in this category, including the numbers of small businesses. In this category, the Census breaks-out data for firms or companies only to give the total number of such entities for 2002, which was 929.

¹⁷ *Id.* An additional 18 establishments had employment of 1,000 or more.

¹⁸ With the exception of the special emergency service, these services are governed by Subpart B of Part 90 of the Commission's rules. 47 C.F.R. §§ 90.15 through 90.27. The police service includes 26,608 licensees that serve state, county and municipal enforcement through telephony (voice), telegraphy (code) and teletype and facsimile (printed material). The fire radio service includes 22,677 licensees comprised of private volunteer or professional fire companies as well as units under governmental control. The local government service that is presently comprised of 40,512 licensees that are state, county or municipal entities that use the radio for official purposes not covered by other public safety services. There are 7,325 licensees within the forestry service which is comprised of licensees from state departments of conservation and private forest organizations who set up communications networks among fire lookout towers and ground crews. The 9,480 state and local governments are licensed to highway maintenance service provide emergency and routine communications to aid other public safety services to keep main roads safe for vehicular traffic. The 1,460 licensees in the Emergency Medical Radio Service (EMRS) use the 39 channels allocated to this service for emergency medical service communications related to the actual delivery of emergency medical treatment. 47 C.F.R. §§ 90.15 through 90.27. The 19,478 licensees in the special emergency service include medical services, rescue organizations, veterinarians, handicapped persons, disaster relief organizations, school buses, beach patrols, establishments in isolated areas, communications standby facilities and emergency repair of public communication facilities. 47 C.F.R. §§ 90.33 through 90.55.

¹⁹ See 13 C.F.R. § 121.201 (SIC Code 4812).

²⁰ See 5 U.S.C. § 601(5) (including cities, counties, towns, townships, villages, school districts, or special districts).

²¹ 5 U.S.C. § 601(5).

²² U.S. Census Bureau, Statistical Abstract of the United States: 2006, Section 8, page 272, Table 415.

we estimate that most governmental jurisdictions are small.

8. *Estimates for PLMR Licensees.* Private land mobile radio systems serve an essential role in a vast range of industrial, business, land transportation, and public safety activities. These radios are used by companies of all sizes operating in all U.S. business categories. Because of the vast array of PLMR users, the Commission has not developed a definition of small entities specifically applicable to PLMR users, nor has the SBA developed any such definition. The SBA rules do, however, contain a definition for small radiotelephone (wireless) companies.²⁴ Included in this definition are business entities engaged in radiotelephone communications employing no more than 1,500 persons.²⁵ The SBA has developed a small business size standard for wireless firms within the two broad economic census categories of "Paging"²⁶ and "Cellular and Other Wireless Telecommunications."²⁷ Under both categories, the SBA deems a wireless business to be small if it has 1,500 or fewer employees. For the census category of Paging, Census Bureau data for 2002 show that there were 807 firms in this category that operated for the entire year.²⁸ Of this total, 804 firms had employment of 999 or fewer employees, and three firms had employment of 1,000 employees or more.²⁹ Thus, under this category and associated small business size standard, the majority of firms can be considered small. For the census category of Cellular and Other Wireless Telecommunications, Census Bureau data for 2002 show that there were 1,397 firms in this category that operated for the entire year.³⁰ Of this total, 1,378 firms had employment of 999 or fewer employees, and 19 firms had employment of 1,000 employees or more.³¹ Thus, under this second category and size standard, the majority of firms can, again, be considered small. Thus, under this size standard, the majority of firms can be considered small. For the purpose of determining whether a licensee is a small business as defined by the SBA, each licensee would need to be evaluated within its own business area. The Commission's fiscal year 1994 annual report indicates that, at the end of fiscal year 1994, there were 1,101,711 licensees operating 12,882,623 transmitters in the PLMR bands below 512 MHz.³²

IV. Description of Projected Reporting, Recordkeeping and Other Compliance Requirements

9. Equipment manufacturers need to make note of the new implementation date of January

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²³ We assume that the villages, school districts, and special districts are small, and total 48,558. See U.S. Census Bureau, Statistical Abstract of the United States: 2006, section 8, page 273, Table 417. For 2002, Census Bureau data indicate that the total number of county, municipal, and township governments nationwide was 38,967, of which 35,819 were small. *Id.*

²⁴ See 13 C.F.R. § 121.201, NAICS code 517212.

²⁵ *Id.*

²⁶ 13 C.F.R. § 121.201, NAICS code 517211.

²⁷ 13 C.F.R. § 121.201, NAICS code 517212.

²⁸ U.S. Census Bureau, 2002 Economic Census, Subject Series: Information, "Establishment and Firm Size (Including Legal Form of Organization)," Table 5, NAICS code 517211 (issued Nov. 2005).

²⁹ *Id.* The census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

³⁰ U.S. Census Bureau, 2002 Economic Census, Subject Series: Information, "Establishment and Firm Size (Including Legal Form of Organization)," Table 5, NAICS code 517212 (issued Nov. 2005).

³¹ *Id.* The census data do not provide a more precise estimate of the number of firms that have employment of 1,500 or fewer employees; the largest category provided is for firms with "1000 employees or more."

³² See Federal Communications Commission, 60th Annual Report, Fiscal Year 1994 at 120-121.

1, 2011, for 47 C.F.R. § 90.203(j)(4)-(5) of the Commission's Rules, as established in this *Third Report and Order*. Applications for equipment certification and received on or after January 1, 2011, will be granted only if the equipment either (1) is capable of operating on 6.25 kHz channels, or (2) meets a narrowband efficiency standard, i.e., one channel per 6.25 kHz (voice) or 4800 bits per second per 6.25 kHz (data). We believe that both small and large entities will encounter the same proportional costs to comply with these requirements.

V. Steps Taken to Minimize Significant Economic Impact on Small Entities and Significant Alternatives Considered

10. The RFA requires an agency to describe any significant alternatives that it has considered in developing its approach, which may include the following four alternatives (among others): “(1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities; (3) the use of performance rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for such small entities.”³³

11. The only rule change we adopt herein is to delay the implementation date of our certification requirements from January 1, 2005, to January 1, 2011. Applications for equipment certification received on or after January 1, 2011, will be granted only if the equipment either (1) is capable of operating on 6.25 kHz channels, or (2) meets a narrowband efficiency standard, i.e., one channel per 6.25 kHz (voice) or 4800 bits per second per 6.25 kHz (data). This rule change reduces the impact on equipment manufacturers of the prior rule, which required compliance sooner. We delayed the implementation date because a majority of commenters believed that enforcing an equipment authorization cut-off now would place onerous burdens on manufacturers. We anticipate that small licensees will experience little impact as a result of this rule change. By 2011, licensees in the market for new equipment will have a choice between 12.5 kHz-capable and 6.25 kHz-capable equipment.

12. We investigated alternatives to the January 1, 2011, implementation date of our certification requirements, including elimination of the requirements, as requested by some commenters. We rejected earlier dates because they might not allow enough time for 6.25 kHz standards to be finalized. We believe that earlier dates would not provide significant relief to equipment manufacturers, and that they would incur excessive costs to meet our certification requirements. Next, we considered dates after 2011, as well as eliminating our 6.25 kHz equipment certification requirements completely. While we realize that these options would further minimize the economic impact on equipment manufacturers, we rejected these options they would excessively delay our objective to encourage the development and use of spectrally efficient technology.

VI. Report to Congress

13. The Commission will send a copy of this *Third Report and Order*, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act, see 5 U.S.C. § 801(a)(1)(A). In addition, the Commission will send a copy of the *Third Report and Order*, including this FRFA, to the Chief Counsel for Advocacy of the Small Business Administration. A copy of the *Third Report and Order* and FRFA (or summaries thereof) will also be published in the Federal Register. See 5 U.S.C. § 604(b).

³³ 5 U.S.C. § 603(c)(1) – (c)(4).

Icom Talking Points

6.25 kHz FDMA vs. 12.5 KHz TDMA

Issue	Motorola Point of View	Icom Point of View	Comments
Technology - Description	<p>FDMA – splits a channel into 2 ea 6.25 kHz</p> <p>TDMA – achieves equivalency of 2 ea 6.25 kHz channels with two time slots within one 12.5 kHz channel</p> <p>“Preserves the full channel width”</p>	<p>FDMA – Does not split any existing channels. Operates on one unique channel within the FCC established 6.25 kHz emission mask.</p>	<p>Important for us to draw this distinction, since TDMA must find an available 12.5 kHz channel (hard to do these days) while we can use any available 6.25 kHz channels no matter where they are within the 70 MHz band width of the radio.</p> <p>“Preserving full channel width” is actually a disadvantage in this case</p>
Standards approved and accepted world wide	<p>FDMA – is not an accepted standard world wide and has no support from world bodies; it is proprietary.</p> <p>TDMA- is P25 Phase II and also ETSI Tier 2 Standard. Well proven technology, not proprietary but “standards based.”</p>	<p>In US, 12.5 kHz FDMA is the P25 Phase I Analog standard</p> <p>FDMA is an ETSI standard, TDMA is an ETSI standard, there is no difference.</p> <p>FDMA has been adopted by the European Electronic Communications Committee.</p> <p>In Japan - Land Mobile Radio Association Corporation (Rikujyou Musen Kyoukai) and Association of Radio Industries and Business (ARIB) are developing standards based on FDMA</p>	<p>FDMA is fully recognized world wide as a legitimate technology.</p>

For comparison and training purposes only, based on "TDMA Technology. Bringing Increased Capacity and Functionality to Professional Two Radio", a white paper published by Motorola, Inc., and interpretation of same. All data should be confirmed by the reader prior to making any decisions or drawing any conclusions. Current data may be procured from the appropriate manufacturer. No fitness of purpose for any specific application is claimed or asserted in this comparison.

Issue	Motorola Point of View	Icom Point of View	Comments
Regulatory Situation	<p>No current mandate by FCC to move to 6.25kHz (discussions are continuing however)</p> <p>The next logical step is to increase efficiency of 12.5 kHz channels</p> <p>Only a matter of time before two voice paths in a single 12.5 kHz channel will be required</p> <p>This is also known as 6.25 equivalent efficiency</p> <p>Two slot TDMA is a way to divide one 12.5 kHz channel in half and achieve this equivalency “today”</p>	<p>FCC has made it very clear they wanted “on channel” spectral efficiency at 6.25 kHz</p> <p>Their 1995 FCC rule revision, to receive FCC Certification after January 1st, 2005, said manufacturer’s must Include a 6.25kHz channel bandwidth device, or...Spectral efficiency standard of one voice channel per 12.5kHz channel.</p> <p>Wireless device manufacturers were required to develop a technical method to satisfy this requirement.</p> <p>The FCC proceeded immediately to create approximately 500 UHF 6.25 kHz channels, which have mostly remained unlicensed because no equipment existed.</p> <p>In addition, the VHF band plan was revised around a 7.5 kHz channel width band plan.</p>	<p>Only Icom has a solution today.</p> <p>Channels are ready to be licensed on their own, and not necessarily a subdivision of an existing channel.</p> <p>The new rules would be in place now if Motorola had not petitioned the FCC for a “stay.” Still no ruling by the FCC.</p> <p>It is not clear that the FCC will require two voice paths in a single 12.5 kHz channel; they may require the original standard.</p> <p>Some licenses may only require a new emission designator.</p> <p>Hedge the loss of 25 kHz channels in 2013 by licensing the underlying 6.25 kHz channels now.</p>
Proven technology	<p>12.5 kHz TDMA is a proven technology</p> <p>6.25 kHz FDMA is not a proven technology in real world implementation</p>	<p>FDMA is a proven technology, albeit never at 6.25 kHz. But it has been used in 5kHz in Europe for years.</p> <p>It is currently being used in Europe for the dPMR standard.</p> <p>Many US manufacturers testified that it was impossible.</p> <p>AMBE+2 Vocoder made by the same company making P25 vocoder (DVSI).</p>	<p>Icom solved the technology challenges and created this new technology and will now prove it will work in the US as it is in Europe.</p> <p>There is actually no 12,5kHz application of TDMA2 in use.</p>

For comparison and training purposes only, based on “TDMA Technology. Bringing Increased Capacity and Functionality to Professional Two Radio”, a white paper published by Motorola, Inc., and interpretation of same. All data should be confirmed by the reader prior to making any decisions or drawing any conclusions. Current data may be procured from the appropriate manufacturer. No fitness of purpose for any specific application is claimed or asserted in this comparison.

Issue	Motorola Point of View	Icom Point of View	Comments
Adjacent channel interference	<p>12.5 kHz has no adjacent channel interference.</p> <p>Operates on existing 12.5 kHz channels which are already licensed and regulated.</p>	<p>Interference exists today on 12.5 kHz and 25 kHz channels. Adding TDMA to existing channels does not reduce interference.</p> <p>6.25 kHz channels are independent and unique. The frequency coordinator has complete discretion to locate and license channels to minimize interference.</p> <p>The ‘closest’ interferer to an FDMA user is the adjacent channel, the ‘closest’ interferer to a TDMA user will be the user who has the other timeslot. In the TDMA case, the interferer is actually co-channel!</p> <p>Newly assigned channels do not have to be co-located on the band. The coordinator can piece together the best plan possible for the location.</p> <p>Some users with exclusive 25 kHz or 12.5 kHz channels may choose to split them into 2 or 4 6.25 kHz channels, but in this case there would be no interference.</p> <p>Some co channel users may request the same but the frequency coordinator will make sure no additional interference is created...that is their job!</p>	<p>Important to draw the distinction between splitting a 12.5 kHz channel in two and using a unique and independent 6.25 kHz channel.</p> <p>Much more flexibility with 6.25 kHz.</p> <p>Interference will be no worse than it is today (same as TDMA).</p> <p>On VHF, the 7.5 kHz channels will no longer rely on geographic separation with 6.25 kHz.</p> <p>How will 12.5 kHz TDMA work on the VHF band plan?</p> <p>What is the co-channel dynamic range of a TDMA transceiver?? It isn’t measured anywhere.</p>
FDMA Performance –	To meet the emission mask, signal deviation must be smaller than a single 12.5 kHz signal (height and width).Smaller deviation means reduced sensitivity. Reduces effective signal range in real world conditions.	<p>True, reduced deviations will slightly reduce decode sensitivity. However reduced bandwidth will slightly increase RF sensitivity. The net effect is they cancel out.</p> <p>Oscillator technology is not a problem. Professional SSB equipment is far more</p>	This is simply not an issue an issue that will affect actual useage.

For comparison and training purposes only, based on "TDMA Technology. Bringing Increased Capacity and Functionality to Professional Two Radio", a white paper published by Motorola, Inc., and interpretation of same. All data should be confirmed by the reader prior to making any decisions or drawing any conclusions. Current data may be procured from the appropriate manufacturer. No fitness of purpose for any specific application is claimed or asserted in this comparison.

Issue	Motorola Point of View	Icom Point of View	Comments
	<p>Very little toleration for errors introduced by oscillator aging. 6.25 kHz signals contain more energy near the edges of the mask.</p> <p>More prone to adjacent channel interference. Also near/far interference Reduced quality of service in real world situations</p>	<p>demanding and no less possible.</p> <p>6,25k is marginally more prone to adjacent channel interference than 12,5k, but as there are double the number of physical channels available it is statistically less likely to occur.</p> <p>Near/far interference is related to basic receiver architecture; it can affect TDMA and FDMA to the same extent. Only when totally different modulation schemes such as CDMA are considered does this have any meaning.</p>	
Two Slot TDMA Performance	<p>A proven method for achieving 6.25 kHz equivalence in 12.5 kHz repeaters. Uses the full channel width instead of dividing it.</p> <p>Divides it into two time slots Doubles capacity while preserving the 12.5kHz RF performance</p> <p>Propagation and performance are the same as today's 12.5 kHz signals Can work with a single 12.5 kHz repeater channel</p> <p>Twice the capacity of analog with proven performance.</p>	<p>FDMA requires no infrastructure to operate, there is a "talk around" mode that retains the on channel spectral efficiency.</p> <p>Requires no elaborate and expensive infrastructure and exotic protocols (packing 60 milliseconds into a 30 millisecond time slot).</p> <p>MOS for audio quality exceeds that of P25 Phase I radios.</p> <p>BER for signal reliability exceeds that of P25 Phase I radios.</p> <p>Useable range is equal to existing analog radios.</p> <p>Audio remains strong and clear as the useable range is approached.</p>	<p>Important to stress the simplex and repeater operation (future).</p> <p>TDMA will only achieve double capacity IF you can find 2 separate users in EXACTLY the same geographic area, who need EXACTLY the same RF coverage to share the RF channel. Experience shows this is unlikely to happen.</p>
Equipment costs	<p>No new repeaters required. No expensive combining equipment. No loss in signal quality due to combining</p>	<p>Although it does take a repeater for each channel, these will be affordable and more than offset the cost of elaborate infrastructure.</p> <p>Subscriber units are less expensive also. Icom breakthrough technology uses existing FM</p>	<p>Total acquisition cost will be lower with FDMA.</p> <p>If we develop a linear repeater, we would not require one per channel.</p>

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Issue	Motorola Point of View	Icom Point of View	Comments
		<p>radio hardware to keep costs down and reliability up.</p> <p>No expensive combining equipment if channels are spaced properly (not “splitting” a 12.5 kHz channel).</p> <p>6.25 kHz radios are backwards compatible to existing 25/12.5 kHz analog fleets. Not necessary to replace entire fleet at once.</p>	
Future applications	<p>Carry two half duplex conversations Use the second time slot for other applications</p> <p>Reverse channel signaling Priority call control Remote control of the transmitting radio Emergency call preemption Transmitting data such as text messaging Location data</p> <p>Temporarily combine slots for increased data capacity FDMA does only half-duplex calling</p>	<p>IP based technology will permit the development of multi site networks and remote control using the internet.</p> <p>Future voice/data upgrades will enable new applications.</p> <p>Integrated PV and VOIP applications.</p>	<p>FDMA will grow into the IT/IP applications a growing enterprise is interested in.</p> <p>All TDMA ‘developments’ in blue will no longer comply with the 2 channels in 12,5kHz principle. A single user will now occupy the whole channel.</p> <p>Duplex is marketing red herring, most professional radio users realize that duplex = 2 persons talking and no-one listening.</p>
Longer Battery Life	<p>Increase battery life by decreasing transmit drain</p> <p>Each call uses only one of the 2 time slots</p> <p>Requires only half of the transmitter’s capacity, transmitter is idle half the</p>	<p>All of the future developments of TDMA listed above rely on a single user employing both of the available timeslots. Therefore all future developments will negate these savings.</p> <p>Narrowband solutions will always be able to offer increased receiver sensitivity that could permit the user to operate with lower RF powers</p>	

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	<p>time</p> <p>Transmitter normal accounts for 80% of drain in 5-5-90</p> <p>TDMA cuts the effective transmit time in half</p> <p>Reduces current drain to 40% during transmit</p>		
EMC and other problems		<p>TDMA has the disadvantage of creating interference at a frequency which is directly connected to the timeslot length. This normally results in unwanted audible responses from other electronic equipment. TDMA interference is perceptibly more annoying to users and many European EMC standards have been modified to include such TDMA based EMC testing.</p>	
Direct Mode		<p>When operating outside the range of the TDMA controller infrastructure it becomes extremely complex to offer a peer-to-peer 'direct mode' of communication as the integrity of the TDMA timings would be lost. It is likely that such direct mode outside of the TDMA infrastructure would have to revert to FDMA.</p> <p>FDMA is perfectly suited to both infrastructure mode and direct mode.</p>	

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