

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

In the Matter of)	
)	
Promoting Expanded Opportunities for)	ET Docket No. 10-236
Radio Experimentation and Market Trials)	
under Part 5 of the Commission's Rules and)	
Streamlining Other Related Rules)	
)	
2006 Biennial Review of)	ET Docket No. 06-155
Telecommunications Regulations – Part 2)	
Administered by the)	
Office of Engineering and Technology (OET))	

**PETITION FOR RECONSIDERATION
OF
MARCUS SPECTRUM SOLUTIONS LLC**

May 22, 2013

SUMMARY

Marcus Spectrum Solutions LLC, a participant in this proceeding, petitions the Commission to delete or modify the new rule provision that prohibits experimental licenses that have emissions that impinge into passive allocations such as for radio astronomy regardless of whether they have any potential for interference to the passive services. While this provision is well intended, its application to the upper frontier of commercial spectrum use will inhibit experimentation and make it much more costly. A contradiction between the discussion in the R&O and the text of the new rules leads to the possibility that the rule in its present form was an unintentional drafting error that was overlooked in review and adoption. An alternative approach that follows the text of the R&O is suggested to balance better the legitimate important need of protecting the passive services with the Commission's §303(g) mandate to

“(s)tudy new uses for radio, provide for experimental uses of frequencies, and generally encourage the larger and more effective use of radio in the public interest.”

BACKGROUND

Marcus Spectrum Solutions LLC (MSS) is the consulting practice of Michael J. Marcus, Sc.D., F-IEEE, a retired senior executive from FCC who worked at the Commission nearly 25 years in both the spectrum policy and enforcement areas. His qualifications are well known to the Commission¹. These comments are not being submitted on the behalf of any client and are being submitted purely in the public interest.

The long standing provisions of §5.85(a) of the Commission's Rules provide for what frequencies may be used for experiments authorized in the Experimental radio Service. These provisions presently state:

§ 5.85 Frequencies and policy governing their assignment.

- (a) Stations operating in the Experimental Radio Service may be authorized to use any government or non-government frequency designated in the Table of Frequency Allocations set forth in part 2 of this chapter, provided that the need for the frequency requested is fully justified by the applicant.

The Report and Order in Docket 10-236² changes these long standing provisions to read

§ 5.85 Frequencies and policy governing their assignment.

- (a) Stations operating in the Experimental Radio Service may be authorized to use any Federal or non-Federal frequency designated in the Table of Frequency Allocations set forth in part 2 of this chapter, provided that the need for the frequency requested is fully justified by the applicant, except that experimental stations may not use any frequency or frequency band exclusively allocated to the passive services (including the radio astronomy service). Stations authorized under subparts E and F are subject to additional restrictions. (Emphasis added)

This new provision was proposed in the draft rules contained in the Notice of Proposed Rulemaking (NPRM)³ without any explanation. In the Report and Order

¹ FCC Press Release, "FCC Engineer Michael J. Marcus Honored by Institute of Electrical and Electronics Engineers (IEEE)" February 3, 2004, (http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-243463A1.pdf)

² 78 F.R. 25138 (April 29, 2013) "R&O"

(R&O) there is little discussion, but the little there is seems to contradict the letter of the rule that was adopted.

The R&O states:

Decision. As an initial matter, we concur with APCO that, consistent with current rules, experimental licenses of all kinds should avoid use of public safety frequencies except when a compelling showing can be made that use of such frequencies is in the public interest. On the other hand, we believe that SIA's concerns regarding interference to other services are unfounded. An examination of the frequency bands in Section 15.205 reveals that, generally, it is the safety-of-life services, including aviation services, and passive services that have been designated as restricted. Experimenters who desire to use these bands may still do so, but they must apply for a conventional experimental license and be subject to the case-by-case review inherent in that process. Thus, as proposed, the rules we adopt herein will not provide authority for program licensees to operate on specific public safety and passive frequency bands. Parties interested in conducting experiments on these restricted frequency bands must apply for a traditional conventional experimental license and provide the required showing.⁴ (References deleted and emphasis added)

The above text is contained in Section B.3 of the R&O which deals with the new “program licenses” and seems very reasonable in the context of program licenses.

However, the new text in §5.85(a) goes beyond this requirement of making a showing and provides for a total prohibition of any radio experiments regardless of whether there is a real threat of interference to passive services.

The new language seems to insert the provisions of Table of Allocations Footnote US246⁵ into the Part 5 Rules for the first time. Some may argue that this is mandated

³ NPRM, Docket 10-236, November 30, 2010
(http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-10-197A1_Rcd.pdf)

⁴ R&O at para. 56

⁵ 47 C.F.R. 2.106

by ITU Radio Regulations Footnote 5.340, which is a treaty obligation of the U.S.⁶ and would appear to be binding on the Commission. This footnote provides:

5.340 All emissions are prohibited in the following bands:

1 400-1 427 MHz,	
2 690-2 700 MHz,	except those provided for by No. 5.422 ,
10.68-10.7 GHz,	except those provided for by No. 5.483 ,
15.35-15.4 GHz,	except those provided for by No. 5.511 ,
23.6-24 GHz,	
31.3-31.5 GHz,	
31.5-31.8 GHz,	in Region 2,
48.94-49.04 GHz,	from airborne stations
50.2-50.4 GHz ² ,	
52.6-54.25 GHz,	
86-92 GHz,	
100-102 GHz,	
109.5-111.8 GHz,	
114.25-116 GHz,	
148.5-151.5 GHz,	
164-167 GHz,	
182-185 GHz,	
190-191.8 GHz,	
200-209 GHz,	
226-231.5 GHz,	
250-252 GHz. (WRC-03)	

However, ITU Radio Regulation 4.4 , “RR 4.4”, provides

4.4 Administrations of the Member States shall not assign to a station any frequency in derogation of either the Table of Frequency Allocations in this Chapter or the other provisions of these Regulations, except on the express condition that such a station, when using such a frequency assignment, shall not cause harmful interference to, and shall not claim protection from harmful

⁶ This discussion ignores the issue that Radio Regulation Footnote 5.340 was adopted at WRC-03 and the Final Acts of WRC-03 has not been ratified by the Senate so it is not actually a treaty obligation at the moment. *See* Department of State, United States Treaties in Force - A List of Treaties and Other International Agreements of the United States in Force on January 1, 2012 at p. 466-472 (<http://www.state.gov/documents/organization/202293.pdf>)

interference caused by, a station operating in accordance with the provisions of the Constitution, the Convention and these Regulations. (Emphasis added)⁷

Thus under the terms of RR4.4 the U.S. is allowed to use frequencies that violate provisions such as FN 5.340 as long as that use does not cause actual harmful interference to other ITU signatories whose use is compliant with FN 5.340.

MSS strongly supports the general concept of protection of the passive services. Dr. Marcus served as an invited reviewer for the National Academy of Sciences' Committee on Radio Frequencies (CORF) report on the need to protect passive services, "Spectrum Management for Science in the 21st Century"⁸ as well as its report "Handbook of Frequency Allocations and Spectrum Protection for Scientific Uses"⁹. But the Commission is charged to "(m)ake such regulations not inconsistent with law as it may deem necessary to prevent interference between stations"¹⁰, not to protect allocations whether or not they are actually used in a given area at a given time.

PROBLEMS CREATED BY THE NEW §5.85(a)

The new language has a flat prohibition of any experimental assignment on "any frequency or frequency band exclusively allocated to the passive services (including the radio astronomy service)." While this would be understandable for experiments that

⁷ ITU Radio Regulation 4.4

⁸ National Academy of Sciences/National Research Council, Spectrum Management for Science in the 21st Century, 2010 (http://www.nap.edu/catalog.php?record_id=12800)

⁹ National Academy of Sciences/National Research Council, "Handbook of Frequency Allocations and Spectrum Protection for Scientific Uses", 2007 (http://www.nap.edu/catalog.php?record_id=11719)

¹⁰ 47 U.S.C. 303(f) emphasis added

involved preproduction models of equipment that was intended for mass production, the purposes of the Experimental Radio Service are much broader. The Commission's experimental rules also expressly include provisions for the following types of experiments:

- Experimentations in scientific or technical radio research.
- Experimentations under contractual agreement with the United States Government, or for export purposes.
- Technical demonstrations of equipment or techniques.
- Testing of medical devices that use RF wireless technology or communications functions for diagnosis, treatment, or patient monitoring.
- Development of radio technique, equipment, operational data or engineering data, including field or factory testing or calibration of equipment, related to an existing or proposed radio service.¹¹

Did the Commission intend to forbid these even if the circumstances of the experiment posed zero interference risk to the passive services?

There are legitimate reasons for short term experiments in some of the bands allocated for passive use, notwithstanding the viewpoints stated by National Radio Astronomy Observatory in its comments.¹² The exclusive passive bands are given in US246 as

“73-74.6 MHz, 608-614 MHz, except for medical telemetry equipment, 1 1400-1427 MHz, 1660.5-1668.4 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.7 GHz, 15.35-15.4 GHz, 23.6-24 GHz, 31.3-31.8 GHz, 50.2-50.4 GHz, 52.6-54.25 GHz, 86-92 GHz, 100-102 GHz, 109.5-111.8 GHz, 114.25-116 GHz, 148.5-151.5 GHz, 164-167 GHz, 182-185 GHz, 190-191.8 GHz, 200-209 GHz, 226-231.5 GHz, 250-252 GHz.”¹³

¹¹ 47 C.F.R. 5.3

¹² Comments of National Radio Astronomy Observatory, Docket 10-236, January 7, 2011 (<http://apps.fcc.gov/ecfs/document/view?id=7021025271>)

¹³ 47 C.F.R. 2.106 FN US246

In the bands below approximately 30 GHz technology is well known and components are readily available. However in in such lower frequencies testing new concepts in modulation, high bandwidth, or other technical details might be very expensive if it required custom made equipment for an experiment. If standard test equipment or other readily available components could be used for an experiment the cost of the experiment would be much less. Thus there is a valid reason to verify concepts at a frequency that can be readily implemented before trying to build more expensive implementations at a frequency where a long term authorization is possible. As frequencies move above 100 GHz these concerns become even more valid as component availability is very limited and components are very expensive.

At present, 100-102 GHz and 109.5-111.8 GHz are exclusive passive bands. The intervening band, 102-109.5 GHz has both active and passive allocations. On January 3, 2013, the Defense Advanced Research Projects Agency (DARPA) published a Broad Agency Announcement (BAA) entitled “100 Gb/s RF Backbone (100G)”¹⁴. This new program shows the potential of wireless terrestrial and fixed satellite service links with bandwidths greater than 100 gigabits/sec. While 102-109.5 GHz would be a promising place for such technology, initial experiments with such technology would be burdened with additional expense under the new §5.85(a) because transmitters would need tight filters to protect the lower and upper passive bands regardless of whether they are actually used at the place and time of the experiment. Since present FCC radio

¹⁴ DARPA Broad Agency Announcement, 100 Gb/s RF Backbone (100G), Strategic Technology Office, January 3, 2013, (https://www.fbo.gov/index?s=opportunity&mode=form&id=4619343645998c46a527ff5b7ae2a755&tab=core&_cview=1); Proposer’s Day briefing at www.darpa.mil/WorkArea/DownloadAsset.aspx?id=2147486179

service rules implicitly forbid any nonexperimental license or unlicensed use above 95 GHz, filters in the 100 GHz area are not available in production units as there is no market for them due to the “chicken and egg” problem.

Thus an applicant seeking to try cutting edge advanced high speed modulation in the 102-109.5 GHz band for *any* experiment *anywhere* in the FCC’s jurisdiction would be forced under the new §5.85(a) to commission the design and manufacture of an expensive new filter merely to satisfy the requirements of the new rule with no tangible benefit to anyone, except perhaps the filter manufacturer. In many locations the use of such a filter would be of no tangible benefit to any actual passive spectrum use since such use is now very limited in space and time and the propagation in this band is primarily limited by atmospheric absorption, not by the propagation issues at much lower bands.

Just because an experiment is initially performed in a passive band there should not be an automatic assumption of a long term desire of the experimenter to “squat” in passive spectrum and create an “adverse possession” situation. But if this is a real concern of the passive community a much less burdensome way to address that issue is to require the showing that is discuss in paragraph 56 of the R&O but not included in the revises §2.85(a). Further the Commission could also require any applicant who seeks use of a passive band for an experiment to acknowledge in writing that he is aware of the passive allocation, the prohibition against any nonexperimental use of the band, and has an experimental plan to move the experiment to a band which is more appropriate as the experiment achieves its goals.

Lest the Commission think this concern about overprotection of passive allocations is a theoretical one, we have included Attachment I, a rejection letter from the FCC staff in the case of experiment license application File 0350-EX-ST-2013. This application sought to use a center frequency of 105.75 GHz with a bandwidth of 10 GHz at a single location in Columbus, Ohio. While this application was processed under the old rule before the effective date of the amendments in the R&O, it was

“was dismissed because the frequency bands 100-102 GHz and 109.5-111.8 GHz are reserved exclusively for passive services (radio astronomy, earth exploration-satellite and space research).”

It appears from anecdotal reports that FCC sent this application to NTIA, and then NTIA sent it to IRAC. 3 IRAC member agencies objected to the application so the routing of the NTIA/IRAC reply retraced the routing of the application in reverse resulting in this dismissal letter from FCC staff. There is no indication that the proposed limited use in Columbus, Ohio ever posed an interference threat to any specific passive system. Under the newly adopted wording of §2.85(a) the FCC staff would probably reject the application out of hand and not even send it to NTIA for the perfunctory review there!

While NTIA and IRAC have a longstanding concern about noise “aggregation”¹⁵, the accumulation of radio noise from multiple sources, the case for occasional experimental licenses in the millimeterwave passive bands is very different from the lower bands where they generally have concerns. In particular, noise aggregates only if the radio propagation law has an exponent of 2 as in free space propagation, ground-to-

¹⁵ <http://www.ntia.doc.gov/search/node/aggregation>

air or satellite uplink propagation. For terrestrial propagation at most frequencies the path loss exponent is greater than 2 due to multipath effects. For frequencies above 50 GHz propagation is dominated not by geometric spreading with an exponent of 2 but rather by atmospheric absorption issues with exponential decay of signal strength with distance, analogous to atomic decay with time.¹⁶ Thus for the passive bands above 50 GHz unlimited aggregation is impossible due to absorption issues even *arguendo* if there were a large number of emitters!

In the case of millimeterwave technology above 50 GHz there an additional factor that facilitates protection of actual passive service use where terrestrial, airborne, or satellite based. The beamwidth of an antenna is inversely proportional to its dimensions in terms of wavelength. Millimeterwave bands are named such because of the small wavelengths involves as opposed to 1m wavelength at 300 MHz. Thus for millimeterwave bands very narrow beamwidths less than 1°, inconceivable at lower frequencies, are readily achievable because of the small wavelength. These small beamwidth allow additional protection for cochannel passive use that can be worked out in a frequency coordination process if both sides work in good faith.

Thus, especially at millimeterwave frequencies, passive use can coexist with limited experimental use if attention is paid to locations and times of actual passive observations, propagation path loss,, antenna bandwidth of the experimenter, and antenna pointing to avoid impinging on passive users in allocated bands. Thus the absolute

¹⁶ FCC , Millimeter Wave Propagation: Spectrum Management Implications. OET Bulletin No. 70 (July 1997)
(http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet70/oet70a.pdf)

prohibition in the revised §5.85(a) is simply overkill and less burdensome alternatives are possible.

Finally it is theoretically possible that some new use of a present purely passive band *might* have made public interest benefits that exceed the benefit of the band being used only for passive use. Such a public interest finding would have to be made of the Commission, but the preclusion of *any* experiment in a purely passive band anywhere at anytime seems to prejudge the issue and determine that for all time such passive use is the best and most valued use of the spectrum. It is hard to read into the present Act prejudging such a finding by banning all experimentation in passive bands.

SECTION 7(a) OF THE ACT AND ITS IMPACT ON SECTION 5.85(a)

Section 7(a) of the Communications Act of 1934, as amended, provides

It shall be the policy of the United States to encourage the provision of new technologies and services to the public. Any person or party (other than the Commission) who opposes a new technology or service proposed to be permitted under this chapter shall have the burden to demonstrate that such proposal is inconsistent with the public interest.¹⁷

Since this provision clearly states that “(a)ny person or party (other than the Commission)” who opposes a new technology has the “burden to demonstrate that such proposal is inconsistent with the public interest” it would appear that the “(a)ny person or party” term includes NTIA and all other federal agencies. While NTIA’s spectrum actions on behalf of the President are exempt from the provisions of Sections 301

¹⁷ 47 U.S.C 157(a)

and 303 of the Act under the terms of Section 305 of the Act, they are clearly not exempt from all other provisions of the Act, including §7(a).

Thus the Commission's practice of automatically deferring to NTIA on this issue as a matter of comity or administrative convenience would appear in conflict with the provisions of Section 7(a) which would appear to require NTIA or IRAC members "to demonstrate that such proposal is inconsistent with the public interest" in the case of "new technology". While the Commission does not have a working definition of "new technology" in the context of Section 7, the fact that there is no commercial technology available above 95 GHz today would indicate that at the very least technology above 95 GHz is "new technology".

AN ALTERNATIVE APPROACH TO §2.85(a)

As indicated previously, MSS strongly supports the realistic protection of passive services and recognizes their immense value to our society and economy. But overprotection only inhibits technical progress in use of the radio spectrum in nearby bands where there is no allocated passive use with no tangible benefit to the passive services. Thus in this section we propose alternative approached to balance the costs and benefits while assuring the allocated use by passive systems.

This alternative involves implementation the scheme that is described in paragraph 56 of the R&O and was apparently the intention of the Commission although the wording of the new §2.85(a) is inconsistent. This could be done by modifying §2.85(a) to read:

§ 5.85(a) Frequencies and policy governing their assignment.

Stations operating in the Experimental Radio Service may be authorized to use any Federal or non-Federal frequency designated in the Table of Frequency Allocations set forth in part 2 of this chapter, provided that the need for the frequency requested is fully justified by the applicant, ~~except that experimental stations may not use any frequency or frequency band exclusively allocated to the passive services (including the radio astronomy service).~~ Stations authorized under subparts E and F are subject to additional restrictions. **Experimental stations licensed under Subpart E, F, G, and H may not use any frequency or frequency band exclusively allocated to the passive services (including the radio astronomy service). Any application to use any frequency or frequency band exclusively allocated to the passive services (including the radio astronomy service) must include an explicit justification of why nearby bands that have nonpassive allocations are not adequate for the experiment. Such application must also state that the applicant acknowledges that long term or multiple location use of passive bands is not possible and that the applicant intends to transition any long term use to a band with appropriate allocations.**

MSS believes that no formal public notice to the passive user community is needed for experimental license applications because all the passive bands are shared federal Government/nonfederal Government (G/NG) bands. Thus under the terms of the January 2003 FCC/NTIA Memorandum of Understanding¹⁸ any licensing in such bands is subject to FCC/NTIA coordination. During such coordination NASA, NOAA, and NSF, the funders of almost all passive spectrum use in the US, have an opportunity to comment and, as seen in Attachment I, actually have near veto power. Thus more formal public notice would mainly serve to delay action with little or no public benefit.

¹⁸ Federal Communications Commission, National Telecommunications and Information Administration, Memorandum of Understanding, January 2003 (http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-230835A2.pdf)

CONCLUSION

The new changes to §5.85(a) made in this proceeding unnecessarily restrict wireless technology experiments with no real resulting benefit, especially greater than 95 GHz, the Commission's frontier of permitted use where there are no present FCC service rules. It is possible that the adopted text was a drafting error as they appear to be inconsistent with the discussion in the R&O. MSS has proposed an alternative formulation for §5.85(a) that is consistent with the text of the R&O and strikes a better balance between legitimate need for experimentation and the need to protect the vital passive services.

A handwritten signature in black ink, appearing to read "Michael J. Marcus", enclosed within a thin black rectangular border.

Michael J. Marcus
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May 22, 2013

cc: Julius Knapp
John Leibovitz
Nnake Nweke

Attachment I – FCC letter re: File No. 0350-EX-ST-2013

FEDERAL COMMUNICATIONS COMMISSION
Experimental Licensing Branch
445 12th Street, S.W., Room 7A-321
Washington, D.C. 20554

April 25, 2013

Attn: David W. Nippa
Battelle
505 King Ave.
Columbus, OH 43201

DISMISSED-WITHOUT PREJUDICE

Dear David W. Nippa,

This refers to application, File No. 0350-EX-ST-2013, for an experimental authorization.

You are advised that the Commission is unable to grant your application for the facilities requested. This application was dismissed because the frequency bands 100-102 GHz and 109.5-111.8 GHz are reserved exclusively for passive services (radio astronomy, earth exploration-satellite and space research).

Responses to this correspondence must contain the Reference number : 20001

Sincerely,

Walter Johnston
Chief
Electromagnetic Compatibility Division