



AND THE “BAND” PLAYED ON: THE IMPACT OF LOW POWER FM

by

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ABOUT THE AUTHOR

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THE WISE PROGRAM

The Washington Internships for Students of Engineering Program was started in 1980 with a grant from the National Science Foundation. Dr. Barry Hymen founded the WISE program, modeling it after his own experiences as a Congressional Fellow. The program chooses between fourteen and sixteen students each year about to enter their senior year of an engineering discipline. These students spend their summer learning about how engineering and technology can influence public policy, and how they can impact policy as engineers. Each student also creates his/her own public policy/research paper about a technical issue, utilizing the unique expertise and opportunities available in Washington, DC. For more information about the WISE program, check their web site at <http://www.wise-intern.org>.

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Executive Summary

On January 20, 2000 the Federal Communications Commission created a new class of low power FM (LPFM) radio stations. These new stations would be either 10 or 100 watts and have a broadcasting radius of between one and three miles respectively. In 1979 the Federal Communications Commission banned the licensing of stations of less than 100 watts. The rulemaking action in 2000 allows licensing low power radio stations for the first time in over twenty years and drops third channel adjacency restrictions that have been in place since 1949.

FM radio operates in the electromagnetic spectrum between 88 and 108 MHz. The frequencies which signals are broadcast on the FM band have separations of 200 kHz or 0.2 MHz, or channels. The FCC had until their LPFM rulemaking maintained three channels of protection for each FM station.

In 1996 the U.S. Congress passed the first major revision of telecommunications law since 1934. The 1996 Telecommunications Act led to broad consolidation of the radio industry. LPFM proponents claim this consolidation in broadcasting creates bland programming and decreased access to the airwaves for minority and underrepresented groups, inhibiting democracy and free speech.

Supporters of LPFM include the Federal Communications Commission (FCC) and public interest groups, such as the Media Access Project and the National Lawyers Guild. Those currently in broadcasting oppose low power radio. Opponents of low power radio consist mainly of those currently in the full power broadcasting industry. Their reasons for opposition include technical interference, regulatory concerns, the future of digital audio broadcasting, and the economic impact of LPFM. The involved parties filed comments with the FCC including written reports and commissioned studies regarding the effect of LPFM broadcasting.

In response to the creation of LPFM the House of Representatives passed H.R. 3439. A similar measure has been introduced in the Senate and referred to committee. The House bill greatly limits the introduction of Low Power radio where the Senate bill eliminates new Low Power radio service. While the U.S. Congress attempts to prevent the introduction of this new service, the Federal Communications Commission has begun accepting applications for LPFM licenses.

1 INTRODUCTION TO ISSUE

Technology policy can be a difficult separation of science and politics. One recent issue involving technology policy is the creation of Low Power FM service. This paper explores social and technical issues of Low Power FM radio policy. This includes representation of community interests, rights of current broadcasters, how legislation affects upcoming technologies, and whether Low Power FM stations will cause broadcasting interference. Through close examination and analysis, the issue will be defined, discussed, and a recommendation reached.

2 BACKGROUND

2.1 A Short History of Low Power FM

On January 20, 2000 the Federal Communications Commission issued a Report and Order approving two new classes of noncommercial, low power, FM radio stations.¹ The new service will consist of two classes with maximum power levels of 10 watts and 100 watts, servicing an area of one to two and one half miles respectively. These non-commercial community stations are dubbed Low Power FM, or LPFM.²

Low Power FM is not a new phenomena in American Broadcasting. For decades Low Power Radio has been synonymous with pirate radio. Pirate radio includes all broadcasts not licensed by the Federal Communications Commission. Such broadcasting was popularized in the 1990 film “Pump Up the Volume”. In this film Christian Slater plays an angst-ridden youth in an Arizona suburb, who broadcasts his own pirate radio show. He gives voice to the

¹ Report and Order issued on MM Docket 99-25

undesirable students who feel lost in their community of success and affluence. Slater's character creates a new outlet for community voices, which could be heard at an extremely local level. This has been done by pirate broadcasters for decades. The FCC's decision to allow a new class of LPFM stations creates a legitimate legal form of this type of community broadcasting.

The Report and Order issued by the FCC allows for a new type of radio broadcasting. LPFM will be significantly less expensive than traditional broadcasting, allowing new voices to be heard on the airwaves. The Report and Order proposes to create a non-commercial service for the public by means of the regulation outlined in the Order. The Report and Order attempts to protect the integrity of the electromagnetic spectrum by only allowing stations broadcasting at a maximum power of 100 watts and limiting new spectrum allotments to the third adjacent channel and beyond.

2.2 How FM Radio Works

FM Radio broadcasts on the frequency band between 88 and 108 MHz. Signals are broadcast at frequency separations of 200 kHz. Since we refer to channels given in quantities of Mega (10^6) Hertz, a separation of 200 kHz represents indicates a separation of 0.2 on the radio dial. These separations are referred to as channels.³

To ensure broadcasts on a particular channel can be heard with minimal interference, the FCC created a system restricting use of adjacent channels by FM radio stations. This practice

² Bass, Gwennell L. Waters and Richard M. Nunno. Low Power FM Radio Service: Regulatory and Congressional Issues, CRS Report for Congress, updated May 18, 2000.

³ Proakis, J.G. and M. Salehi. Communications Systems Engineering, 3rd Ed. Prentice Hall pp. 354-356

began in 1949.⁴ The system of three channel protections creates separation of stations within a broadcasting contour, preventing interference. The broadcast channel and three adjacent channels are referred to as the co-channel, first channel, second channel, and third channel.

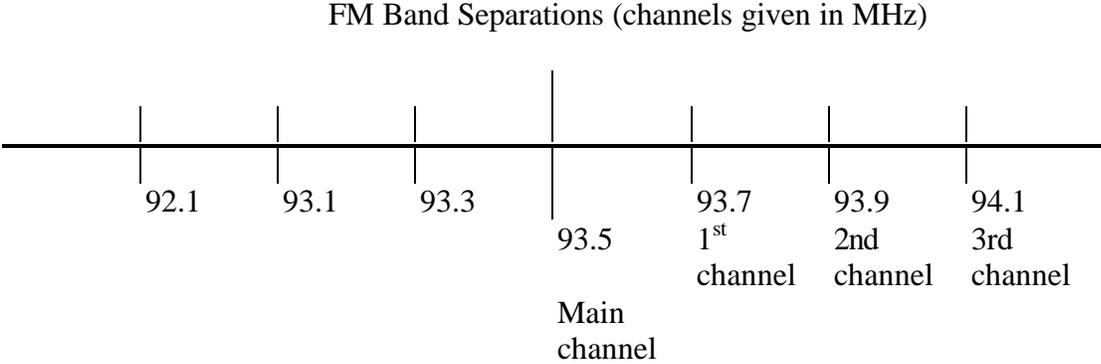


Figure 1: Spectrum Separations in FM Band

These protections ensure no stations broadcast three channels above and below the frequency allotted for any station within a major market. For example, if a station exists at 93.5 FM, under third channel adjacency restrictions, no station can exist on the co-channel, 93.5, the first channel, 93.7, the second channel, 93.9, or the third channel, 94.1. These separations also are enforced for three channels to the left of the main channel.⁵ These restrictions were created to protect FM stations in the same area from interfering with other broadcasters.⁶

⁴ https://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6009048490 as of 7/31/2000

⁵ Proakis, J.G. and M. Salehi. *Communications Systems Engineering*, 3rd Ed. Prentice Hall, pp. 354-356.

2.3 Rules of Radio: How FM Radio Broadcasting is Regulated

The Telecommunications Act of 1934 created the FCC as an independent regulatory agency. Although technology and telecommunications have greatly changed since 1934, this Act remains the main document defining the powers of the Federal Communications Commission. The FCC has rulemaking and regulatory powers over interstate and international communications by radio, television, wire, satellite and cable.⁷

Within the Communications Act of 1934, the basic tenets of the FCC were established. One of these tenets is management of the electromagnetic spectrum as public property subject to Federal Regulation. In this Act, Congress established that lawful broadcasting requires a broadcasting license. It also established the main condition for whether the broadcaster would receive a license hinged upon “the public interest, convenience, and necessity.”⁸

The FCC is an executive branch office with regulatory and judicial powers. It is governed by five Commissioners, who are appointed by the President and confirmed by the Senate. One Commissioner is chosen as chairman by the President, but only three Commissioners may be members of the same political party.⁹

This independent regulatory bureau functioned without significant congressional or executive interference for over sixty years. The first major changes to telecommunications law appear in the 1996 Telecommunications Act. Among other effects this Act eliminates the FCC rules limiting the number of radio stations which can be owned by any single entity.¹⁰ The 1996 Act serves as a force of deregulation and power consolidation. Before this Act, strict regulations

⁶ Bass, Gwennell L. Waters and Richard M. Nunno. Low Power FM Radio Service: Regulatory and Congressional Issues, CRS Report for Congress, updated May 18, 2000.

⁷ <http://www.fcc.gov/aboutus.html>, as of 7/10/00

⁸ <http://www.cep.org.laws.html>, as of 7-5-00

⁹ <http://www.FCC.gov/aboutus.html> as of 7/10/00, as of 07/05/00

existed about the number of radio and television stations that could be owned by one entity. This act greatly relaxed these rules, allowing multiple ownership of multiple media outlets.

The Act also reasserts the power of Congress over the FCC and the telecommunications industry. Many in industry and politics believe the Communications Act of 1996 created a more consumer-friendly and financially stable FM environment. For example, in its reply comments to the FCC, the National Association of Broadcasters asserts that creating entities which own more than one station increases broadcasters ability to diversify radio formats. By having multiple ownership, entities are not as financially dependant on one station and have more room for experimentation.¹¹

3 ARGUMENTS FOR AND AGAINST LOW POWER FM

Whether to allow the FCC to create a new class of Low Power FM stations through regulation is the question now before the United States Congress. Underpinning this question are a number of technical, social, economic and political concerns.

3.1 The Players

Proponents of Low Power FM fall into two classifications: government supporters and public interest groups. Government support for Low Power FM stems from the Federal Communications Commission and the White House. Two public interest groups who favor of Low Power FM are the National Lawyers Guild and the Media Access Project. The two work individually and collaboratively to promote Low Power FM and to help individuals and groups

¹⁰ Cole Raywid and Braverman, LLP Summary of the Telecomm Act of 96, p.11 www.crblaw.com/96summ.html as of 07/05/00

in the LPFM filing process. One group in favor of LPFM, the Media Access Project, is a twenty-five year old public interest telecommunications law firm which supports a program of policy advocacy at the FCC and the Courts, in the media and other public forums. They provide day-to-day counseling of civic organizations and individuals. Another group in favor of LPFM is the National Lawyers Guild, which was founded in 1937 as an alternative to the conservative and racially segregated American Bar Association. In recent years the Guild has fought what they see as the growing anti-poor and anti-immigrant sentiment in this country by providing legal advice and support on these issues. The NLG involvement in the LPFM controversy stems from an organization within the NLG called the Committee for Democratic Communications, or CDC. This committee operates on the principle that free speech and democracy are basic human rights deserving protection under the law.

3.2 Arguments for Low Power FM

3.2.1 Consolidation has created Bland Programming

One argument calling for low power FM radio maintains the mass media consolidation has created a format of radio programming which is too bland and homogenized. The Media Access Project argues a handful of large corporations, which each own hundreds of stations, have transformed radio from a local to a national medium. They believe this has caused a substitution of general management for local decision-making, eliminating newscasts, and imposing bland cookie-cutter program formats.¹²

¹¹ Publication 104-104, Title 2, Sec. 202, (02/08/96)

¹² <http://www.mediaaccess.org/programs/lpfm/fctsht.html>, as of 7/05/00

3.2.2 Access of airwaves to underrepresented groups/communities

LPFM supporters also argue this new service could benefit the community and local interest groups by creating an outlet of communication for these communities. Examples of potential uses of LPFM include an ethnic community broadcasting in their native language or providing English-language instruction. Churches could broadcast religious services, or a high school football game could be broadcast to a local community.¹³ Proponents of Low Power radio believe these are just a few examples of how LPFM could serve communities.

3.2.3 Need for Democratic and Free speech

One report by the Media Access Project cited that 99.9% of the American public has no access to radio broadcasting. The entities that own and control radio make up only 0.1 percent of the American population.¹⁴ In comments to the Federal Communications Commission, the National Lawyers Guild calls for local radio programming as a First Amendment right of Americans to communicate. The Guild argues “a robust democracy requires broad channels of discussion and debate”, and low power radio is the way to create these channels.¹⁵

Proponents of Low Power FM claim concentrated ownership reinforces economic barriers, keeping women and minorities from entering the broadcast industry, both as professionals and as owners. Public interest groups argue that commercial radio stations perceive Hispanic and African-American viewers and listeners as undesirable audiences. They believe this is the reason commercial stations do not create programming aimed towards these audiences. Because they cannot obtain advertising revenue for serving certain demographic

¹³ <http://www.mediaaccess.org/programs/lpfm/fctsht.html>, as of 7//05/00

¹⁴ <http://mediaaccess.org/lpfm>, as of 07/05/00

groups, commercial stations frequently overlook these audiences. Furthermore, the consolidation of stations magnifies this problem by making station owners less aware of their audience and more prone to these stereotypes.¹⁶

3.2.4 The Broadcast Industry Response to pro LPFM Arguments

Current Broadcasters do not believe radio consolidation has led to bland programming. The National Association of Broadcasters maintains diversity has not been decreased by radio consolidation. They assert that while the number of entities who own stations has decreased, the number of formats available to the public has increased.¹⁷

3.3 Arguments Against Low Power FM

Those arguing against low power FM represent primarily the interests of current FM broadcasters. Two of the largest critics of the proposed new LPFM service are the National Association of Broadcasters (NAB) and National Public Radio (NPR). The NAB represents commercial television and radio broadcasters from all over the United States. For seventy-five years the association has represented broadcasting interests in legislative, judicial, and executive matters in Washington, DC.¹⁸ NPR offers syndicated programming, syndicates national programming and runs a member station network. Their involvement in Low Power FM stems from their role as a member station network. As representatives of local stations, NPR protects their interests.¹⁹

¹⁵ https://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=2051500001 as of 07/03/00

¹⁶ <http://www.mediaaccess.org/programs/lpfm/fctsht.html> as of 07/28/00

¹⁷ Executive Summary of National Association of Broadcasters Comments in MM Docket 99-25 Creation of a Low Power FM Radio Service http://www.nab.org/newsroom/issues/lpfm/LPFM_Summary.asp as of 07/05/00

¹⁸ <http://www.nab.org/about/> as of 7/31/00

¹⁹ Interview with Don Lockett, Vice President and Chief Technology Officer of National Public Radio, 6/20/00

3.3.1 Technical Debate: Will LPFM Cause Interference to Existing Broadcasters

One issue paramount to broadcasters is whether the introduction of LPFM will create signal interference by placing these stations on third channel adjacencies. How to resolve this issue became a dilemma to both the FCC and Congress. Existing broadcasters claim new low power FM stations on the previously protected third adjacent channels will cause unacceptable interference to their stations. The technical issues surrounding the creation of a new low power FM service are difficult to judge.

It is difficult to judge the value of one scientific study over another. It is much easier to favor Low Power FM because you think it will help community groups, or to oppose Low Power FM because you feel it will have negative economic implications. Technical arguments become confusing because people want to accept scientific studies as absolute fact. Arguments surrounding LPFM are difficult to discern because as one analysis stated, “each of these four studies examines the same technical question, but the studies are being used to support contradictory conclusions.”²⁰

The National Association of Broadcasters Studies: The National Association of Broadcasters commissioned studies by Moffet, Larson, and Johnson (MLJ) and by the Carl T. Jones Corporation (CTJ). The criteria used in both the MLJ and CTJ tests were based on a concept of SNR, or Signal to Noise Ratio. (See Appendix B on Signal to Noise Ratio.)

National Association of Broadcaster’s studies looked at receiver quality based on Signal to Noise Ratio when a third channel interference was introduced. These tests used the standard of signal degradation below 50 dB, or more than five decibels of degradation, for a signal to

²⁰ A Three Channel Adjacent Receiver Study, Jackson, Charles and Raymond Pickholtz, p.1

experience “harmful interference.” Under this criterion, twenty-two of the twenty-eight radios tested did not meet their standards for performance.²¹

Signal to Noise Ratio is a traditional measurement of signal distortion.²² The NAB chose a five decibel degradation or below fifty dB measurement to represent when a listener will begin to hear audible interference of a signal. With a vested economic interest in the quality reception radio listeners receive, it is understandable that the NAB would set high standards of signal quality. The NAB wants to make sure that no interference can be heard on existing full power FM stations, because a consumer changing the radio station due to poor reception relates to loss of revenue for them.²³

National Public Radio Study: National Public Radio conducted a study with the Consumer Electronics Association, sponsored by the Corporation for Public Broadcasting. Like the National Association of Broadcasters, National Public Radio used signal to noise ratio to determine whether a signal was impaired by third channel interference. (To learn more about SNR read appendix B.) Unlike the National Association of Broadcasters, who used a 50dB standard of performance, National Public Radio used the standard of 45 dB to determine signal quality. Also unlike the NAB, the NPR study did not take into account poorer quality receivers which do not attain 45dB SNR without impairment. Under the NPR study, 13 of the 16 receivers tested failed. The NPR test came to very similar conclusions as the NAB study. They determined that due to the high number of receivers that failed, third channel low power FM stations would cause undue interference to their member stations

²¹ https://gulfoss2.fcc.gov/cgi-bin/websql/prod/ecfs/comsrch_v2.hts,7/18/00, as of 07/05/00

²² In measuring distortion in a communications lab, this is measure commonly used in personal experience

²³ Interview with Mike Waring, Vice President, Government Relations, National Association of Broadcasters, 6/19/00

NPR also had special broadcasting considerations to address. One practice common to NPR is the use of transmitters, or repeaters, which rebroadcast a station in a low population area.²⁴ Under the Report and Order Issued by the FCC, these stations would not receive the same protections as full power stations.²⁵ This would cause increased broadcasting problems to the local national public radio stations.

National Public Radio Programming is also more susceptible to interference than most radio broadcasting. National Public Radio does not modulate its programming, which is primarily classical music and talk. This unprocessed, quieter broadcast signal is therefore more susceptible to detectable third channel interference than a rock or pop station might be.²⁶

The Federal Communications Commission Study: The FCC also conducted a study to determine whether LPFM would cause undue interference. The receiver studies were conducted by FCC's office of Engineering and Technology at their test labs in Maryland. They did not use Signal to Noise Ratio to measure signal quality but instead chose another measurement, claiming the stereo pilot would appear as noise. They chose total harmonic distortion plus noise (THD + N) as their measure of receiver quality, because they were not interested in absolute quality of receivers, but degrees of degradation. (See appendix C on total harmonic distortion.) They established two measurement points, 1% and 3%, stating that interference would be almost undetectable at 1% and would become problematic at the 3% level.

Overall the FCC test labs looked at twenty-one radios. Of the twenty-one, only two radios failed to perform to their specified standard, of three percent total harmonic distortion and noise. Whether this was a legitimate means of judging interference is still unclear. A three

²⁴ Translator, also referred to as repeaters, are stations which rebroadcast a station in a different geographical area

²⁵ Interview with Don Lockett, Vice President and Chief Technology Officer of National Public Radio, 6/20/00

²⁶ Interview with Don Lockett, Vice President and Chief Technology Officer of National Public Radio, 6/20/00

percent THD + N is not necessarily indicative of whether a signal receives interference or not. It is extremely difficult to tell whether these markers of 1% and 3% THD + N are representative as to whether a listener would perceive interference.²⁷ When taking into account the difference between total harmonic distortion plus noise and signal to noise ratio, there is a basic difference between the measurement criteria used by OET when compared to the previous studies. The use of THD + N makes it difficult to compare the OET's study to other receiver studies. Their desire to express third channel interference in degrees of degradation is a sensible one since they are measuring how much a signal is impaired, not how good it was initially. Degrees of degradation can be expressed in SNR. In many ways this choice of THD+N simply made their study more difficult to understand. Three percent THD+N represents a signal of 25-30 dB. This is a relatively low signal quality, when compared to the high quality of compact discs which operate at about 70dB. These lower criteria are the reason why such a large percentage of the receivers were considered not to suffer from third channel interference in the OET study.

The National Lawyers Guild Study: The National Lawyers Guild commissioned a study performed by the Broadcast Signal Lab. This report used the concept of threshold to determine whether a signal was being received, thus not receiving unacceptable interference. This study gave lots of documentation and tables, but was difficult to follow. The NLG study used a different measure of unacceptable interference from the other studies, signal threshold. The concept of threshold in engineering is legitimate, but not an appropriate measure of signal quality. When a receiver reaches its threshold it no longer receives the desired signal. A listener would find the quality of the broadcast impaired quite a bit before this level is reached. The

²⁷ Interview with David Means, Chief, Technical Research Branch, Laboratory Division, Office of Engineering and Technology, 6/16/00

threshold is actually defined as the lowest value of signal that can be detected by the receiver.²⁸ This is certainly not preferable in listening quality, a signal that can barely be received will not meet consumer demands in receiver quality. This criteria is simply not demanding enough, and cannot be used to argue that third channel interference will not occur.

An Analysis of the Four Studies: In examining the FM receiver studies, comparison becomes difficult as all studies submitted lead to a desired criterion. Each organization's study supports their individual agenda making the usefulness of each study difficult to determine. This is certainly not a claim that data is being falsified, but simply that the criterion for what produces interference can be effected by agendas. If your personal agenda is to put new low power stations on the air, the level of interference that you determine to be "acceptable" is quite different than the level of interference considered acceptable to those who have a current stake in full power broadcasting.

²⁸ Booth, Christopher J. Ed. The New IEEE Dictionary of Electronics and Electrical Terms. Institute of Electrical and Electronic Engineers, Inc: 1370

The following is a comparison of the four studies that were submitted to the FCC, detailing strengths and weaknesses in criteria, analysis, and credibility.

<u>Study</u>	<u>Criteria used</u>	<u>is this good criteria?</u>	<u>analysis easily understood?</u>	<u>Credibility</u>
NAB	50dB or 5dB degradation	it makes sense, possibly slightly conservative	NAB's studies relatively easily understood,	Mixed, although tests Performed in traditional Manner, NAB had interest in Proving interference existed
NLG	Transition zones (signal threshold)	no, threshold is a measure of whether signal is being received at all, completely Inappropriate measure of Reception	well documented, lots of information given, so many tables and charts difficult to follow all of them	Similar to NAB, the NLG began Wanting to support LPFM, therefore would expect them to Conclude it does not cause Interference
NPR	45 dB	Same as NAB	like the NLG, the report included a lot of information, which did not make it easy to Read or understand	same as NAB
OET	3% THD +N	not typical method of evaluating receivers, unclear from listening whether it is Legitimate	Good tables explaining Method, also very good flow chart describing test Procedure, easily read	most credible because although Chairman Kennard wanted LPFM, OET is not politically motivated other groups, do not have Economic interests in LPFM

Table 2: A Comparison of the Four Receiver Studies

Beyond this problem inherent in all four studies, each receiver study also made an error reported only by an analysis commissioned by the National Association of Broadcasters and referred to as the Jackson-Pickholtz Report. Each of these studies included car radios in their test data. In each study it was noted that car radios had better reception capabilities than other radios in the test groups. The reason car radios have better reception capabilities, and are more

expensive than traditional radios, is because they operate under moving conditions. They must be able to pick up a signal better than a traditional receiver to achieve the standard of quality consumers expect. These radios are designed to operate in vehicles moving at high speeds, but the tests performed by all four groups were performed in non-moving laboratory conditions. This means that the radios tested in all four studies performed better than they would in real world situations. Therefore, the test data performed on these radios should not be considered in overall receiver analysis.²⁹

Overall, these studies did not conclusively determine that Low Power FM as created in the Report and Order will not cause interference to existing radio stations. Each study chose a different measure of how much interference from third channel could be tolerated, but none of these numbers were based on real world studies. The receiver studies performed cannot ultimately determine whether this new service will create an acceptable service for the public.

3.3.2 Regulation Issues in LPFM

Another concern of broadcasters is the regulation of new LPFM stations. New Low Power FM stations will be required to follow the same rules of broadcasting as any full power FM stations. The FCC must address how it will monitor as many as one thousand new radio stations. The FCC claims that this regulation issue is very often taken care of through the general public. Although people might not call the FCC because of poor radio reception, individuals and other broadcasters are quick to report inappropriate content.³⁰

A new class of LPFM stations would create as many as 1000 new stations for the FCC to regulate. Mike Waring at the NAB suggests, if a low power station feels it is not being heard

²⁹ A Three Channel Adjacent Receiver Study, Jackson, Charles and Raymond Pickholtz, p.1

well enough due to interference, it could decide to increase its broadcasting power. This is a real concern to current broadcasters. The FCC does not feel this is a problem, but does not offer any solution to how LPFM station power could be regulated.³¹

In his dissenting statement on M.M. Docket 99-25, the creation of a Low Power FM service, commissioner Harold Furchtgott-Roth states one of his reasons for nonsupport of LPFM is the regulation issues that might result from this docket. He explains his concern for how Equal Employment Opportunity (EEO) Rules will apply to LPFM stations. According to his statement, these rules apply to all broadcasters, which would include low power broadcasters.³² He explains “the required outreach for EEO alone, not to mention all other regulations, may prove overwhelming for the operators of low-power radio stations”.³³ Commissioner Furchtgott-Roth continues by listing a multitude of regulatory concerns which will have to be addressed by LPFM stations and the commission. The administrative costs of Low power FM will be large. The creation of low power radio requires regulation, including limits on ownership, residency, and operating hour regulations, and will be difficult to enforce.³⁴

3.3.3 Digital Radio: Will New LPFM Stations Impede Progress

One technical issue which has caused much debate in the LPFM issue is its effect on the development of digital radio. The form of digital radio currently being worked on is called In Band On Channel Digital Audio Broadcasting (IBOC DAB), also known as digital radio. IBOC DAB will broadcast digital signals still using the same modulation process as analog radio. In

³⁰ Interview with Bruce A. Franca, Deputy Chief, Office of Engineering and Technology, Federal Communications Commission, 6/28/00

³¹ Interview with Bruce A. Franca, Deputy Chief, Office of Engineering and Technology, Federal Communications Commission, 6/28/00

³² 47 CF section 73.2080(a) Dec 29 1999

³³ Separate Statement of Commissioner Furchtgott-Roth found at http://www.fcc.gov/Speeches/Furchtgott_Roth/Statements/2000/sthfr005.html, as of 08/01/00

this way the spectrum will carry both analog and digital radio signals. This will make the spectrum actually more crowded due to IBOC digital radio. The digital radio signals will surround the traditional analog signal.³⁵

Because IBOC digital radio is a new technology, a fusion of analog and digital radio, no one is sure exactly how allowing LPFM station on third adjacent channels will effect it. Many fear interference from LPFM stations could greatly hinder the development of digital radio. The FCC has claimed that LPFM station will in no way hinder the development of IBOC digital radio.

Other proponents of LPFM, like the Media Access Project, dismiss the idea of slowing down the progress of LPFM until digital radio can be more advanced. They claim “the commission should not refuse to license microradio stations based on the vague possibility that this may one day interfere with a proposed, but as of yet unbuilt, and unauthorized, full power terrestrial digital radio system, the timing and marketplace acceptance of which is a matter of speculation.”³⁶

In their comments NPR points out that all of the proposed systems for IBOC digital radio require co-existence with parent analog FM stations by transmitting at protected levels on adjacent spectrum-the same spectrum LPFM wants to use.³⁷

Because we don’t know if IBOC DAB will work, until we know how we will create Digital Audio Broadcasting, the spectrum should not become even more crowded.³⁸

³⁴ http://www.fcc.gov/Speeches/Furchtgott_Roth/Statements/2000/sthfr005.html, as of 07/26/00

³⁵ <http://www.radiodesign.com/radwrks.htm> as of 7/5/00

³⁶ https://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=2116900001 as of 7/24/00

³⁷ https://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=20481 as of 7/31/00

³⁸ https://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6011258615 as of 07/31/00

3.3.4 Real Costs to Broadcasters

The main concern of the National Association of Broadcasters (NAB) is that interference will cause a loss in listenership. If a listener suffers from interference, their first response is to change the channel or turn off the radio. Even if an interference issue is eventually resolved, he/she will stop listening to the station. If the 1,000 LPFM stations the FCC proposes come into existence, it is impossible to calculate exactly how many millions of Americans will suffer interference.³⁹

It has been shown that with increased audio quality on CDs and tapes, listeners will simply change the station due to lower quality radio broadcasting. Since the advent of more high quality stereo systems and Compact Discs, which have a very high signal to Noise Ratio, listeners have become more sensitive to poor reception. Broadcasters have a real reason to fear decreased listenership from increased interference in more crowded airwaves.⁴⁰

Though commercial-free, NPR also has economic reasons to fear LPFM. NPR has more to fear than most stations in terms of interference. Because of the unique nature of public radio programming, offering mostly classical music and talk, the stations do not modulate their programming as heavily as commercial radio stations. Because of the light modulation of their programming, it is more susceptible to interference than traditional FM stations.⁴¹

NPR member stations depend on underwriting for support of their programming. Underwriting, or donations, comes from both individuals and corporations. If listeners cannot receive programming, this will cause a reduction in personal donations to public radio. People

³⁹ Interview with Mike Waring, Vice President, Government Relations, National Association of Broadcasters, 6/19/00

⁴⁰ https://gullfoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=2048130001 as of 7/05/00

support Public Radio because they listen to the station, if they are unable to listen to an unimpaired signal, they will not support a station. This will also effect the number of corporate underwriters the stations receive. In fact, a decrease in listenership due to interference would hurt public radio in much the same way it hurts commercial radio. With a decrease in listenership due to interference, there is a decrease in financial support.

Beyond the threat of interference reducing funding, National Public Radio also faces another threat. If Low Power FM were to be really successful, providing a viable alternative to commercial broadcasting, it could effectively function in place of public radio. Though this is not a realistic outcome based on the current limited scope of broadcast range and programming of LPFM, it must be considered as a possibility. If LPFM functioned as well as Public Radio as an alternative to commercial radio, the federal government might ask itself why it funds public radio, when LPFM can get the job done without public funding.

In the separate response of FCC Commissioner Michael Powell, the Commissioner addresses the economic concerns he believes LPFM may create. He quotes former FCC Commissioner Ervin S. Dugan,

Broadcast stations that can't stay above water economically can't serve their communities. Broadcasters have always borne a fundamental obligation to provide service in the public interest. Most have borne that obligation quite well, despite occasional adversity. But the FCC and the nation cannot expect broadcasters to fulfill that obligation if the structure and economics of the industry don't permit it.

("Localism Tied to the Tracks?," remarks of Commissioner Ervin S. Dugan, FCC before the Mississippi Association of Broadcasters (June 27, 1992).) The Commissioner here uses this

⁴¹ Interview with Don Lockett, Vice President and Chief Technology Officer of National Public Radio, 6/20/00

quote to explain how both full and Low Power FM stations will not be able to serve their communities if they lose economic viability.⁴²

3.3.5 Reality of LPFM

Applicants for Low Power radio licenses in the first filing window do not fit the description of LPFM detailed by its proponents. The FCC, in particular chairman Kennard, proposed LPFM service as a means of giving voice to the underrepresented. Although he described many groups that he wanted to give access to the airwaves, “from the Haitians of South Florida to the Vietnamese of South Texas,”⁴³ the group which entered the most applications for new LPFM station were the religious right.⁴⁴

4 POLICY OPTIONS

4.1 Legislative Options

The U.S. Congress is currently pursuing alternatives to the FCC’s current LPFM policy through legislation. The FCC was created through an act of Congress and Congress can overstep the powers of FCC through legislation. Although it is not unusual for congress to become involved in telecommunication issues, involvement such as this in a non-commercial, small scale decision is unique.

An alternative to the current FCC rulings in regard to LPFM is legislation from Congress. On April 14, 2000 the United States House of Representatives passed H.R. 3439, known as the

⁴² <http://www.fcc.gov/Speeches/Powell/Statements/2000/stmkp001.html>, as of 7/05/00

⁴³ <http://www.fcc.gov/speeches/kennard/statements/2000/stwek008.html>, as of 7/5/00

Radio Broadcasting Preservation Act. This bill would not allow LPFM stations to be authorized in the protected third channel, therefore eliminating about 75 percent of the potential LPFM licenses. It is estimated that this bill will reduce the number of available LPFM stations from 300-400 down to 70. The Act also requires further investigation by the FCC on whether third channel adjacency restrictions can be dropped without interference concerns and report these findings to Congress.⁴⁵

The United States Senate introduced a bill identical to the original HR 3439, S. 2068 on February 10, 2000. The bill currently has 36 sponsors in the house (as of June 6, 2000), but has yet to be brought up at committee. This bill if passed, would eliminate the low power FM class of stations created by the FCC entirely.

At the same time Senator John McCain introduced S. 2518 on May 8, 2000. The provisions of this bill preserve the technical integrity of the FM radio band while permitting the introduction of LPFM licenses. This bill would allow full power FM stations to sue low power stations in court, making owning a low power FM station a liability that most could not afford, therefore creating a network of LPFM stations as either elitist or defunct.⁴⁶ The McCain Bill also requires the national academy of sciences to determine whether an LPFM station causes harmful interference.⁴⁷ The National Academy of Sciences does not have experience in the electromagnetic spectrum and probably were not a good choice to put in charge of interference concerns.

⁴⁴ <http://nytimes.com/library/financial/071100radio-fcc.html?Partner=abuz,7/11/00>, as of 07/05/00

⁴⁵ Bass, Gwennell L. Waters and Richard M. Nunno. Low Power FM Radio Service: Regulatory and Congressional Issues, CRS Report for Congress, updated May 18, 2000.

⁴⁶ Bass, Gwennell L. Waters and Richard M. Nunno. Low Power FM Radio Service: Regulatory and Congressional Issues, CRS Report for Congress, updated May 18, 2000.

⁴⁷ Bass, Gwennell L. Waters and Richard M. Nunno. Low Power FM Radio Service: Regulatory and Congressional Issues, CRS Report for Congress, updated May 18, 2000.

The Low Power FM issue develops into what all politics becomes, a question of balance and values. To some, like community broadcasters and others, the potential risk of compromising the electromagnetic spectrum is worth the access given to community groups by LPFM. To others, who have interests in current broadcasting or the development of new services, the potential risk of LPFM is not outweighed by the benefits. Those who have current interests in broadcasting claim interference, and those without current interests claim interference will be minimal. It boils down to whether interference will really occur, and how bad it will be, i.e. will it be so bad that an average listener will simply change the station.

The political issues are also based not on just the facts, or policy, but power. In many ways the Report and Order served to reassert power, not the power taken from the community by big broadcasters, but the power taken from the FCC by Congress. Just like the National Lawyer's Guild's interest in LPFM may be based on reasserting the control of lawyers. The broadcasters want to protect the exclusive power of big broadcasters over the airwaves, and the underrepresented want to take power from the broadcasters. The issues are all about power and control, and who has the best studies and arguments to take power, and keep it.

4.2 New Technologies for the Future

There are many new ways in which technology will be able to reach millions. Nokia and Real Networks (maker of Realplayer audio) announced in late June a deal in which they will offer new streamlined video and audio over the wireless internet. To make this new service available Realplayer will offer a scaled down version of its RealPlayer for use on cell phones. The new third generation wireless Internet will be available at speeds six and one-half times faster than today's standard telephone connection. The wireless Internet is a new and exciting

way in which people can communicate. Nokia plans to introduce this new technology in early 2001. With portability and reduced price, Internet radio will be the radio of the future. This, not low power FM, is what the FCC and the congress should be focusing time and effort on.⁴⁸

5. Conclusions and Recommendations

5.1 Conclusions

In the end, the gray area of science causes both engineers and policymakers to doubt the value of technical studies. How can a technical study mean anything if anyone can get a study to support their own agenda? Although sometimes claims are ridiculous, and studies lack credibility, all of the studies submitted in the LPFM proceedings were well presented and relatively credible. How can we trust, judge, or make determinations from these studies. I am not absolutely certain as an engineer, how can policymakers make these decisions?

5.1.1 Technical Interference Conclusions

What measure defines interference is debatable. The receiver tests conducted in the LPFM hearing are not conclusive that third channel restrictions will not cause interference. To do this field and listening tests are needed. By doing more technical studies and listening tests it could be more conclusively determined whether or not the amount of interference caused by LPFM is acceptable for the benefits. These tests, especially listening test, are too expensive and time consuming to be justified for LPFM. The overall costs associated with LPFM, costs not just to broadcasters, but to the listening public and the FCC as a regulatory agency serving the public, do not justify a new class of Low Power FM stations. The current broadcasting system is too valuable for FCC to put at risk. The costs associated with adequate testing, including field tests

⁴⁸ Seattle, AP, Michael J Martinez, 6-28-00

and listening test, would be too expensive to warrant their worth. Instead, new technologies and outlets for the underrepresented should be explored.

5.1.2 Conclusions of Future Radio Technology

The future holds all types of new outlets for communications. Although perhaps everyone does not yet have access to this technology, this does not mean we should stand in the way of new technological development. Radios have not always been available to all at a reasonable price, this came only with increased technological development. As we approach a new digital age people will be able to communicate in new and exciting ways. Although FM continues to be an important medium for communication, it is quickly being replaced by newer technologies. It is my opinion that the FCC should explore new technologies to enable expression, not hamper technological development by promoting old technologies.

Internet radio is not a perfect solution—yet. A report first issued by the NTIA in 1998 and updated in November of 1999 shows right now about 25% of households have computers and 2/3 of those have internet access. The availability of computers outside of the home is increasing and computer prices and other options, like web-TV, are increasing.⁴⁹

The Committee on Democratic Communications is still unconvinced the internet can produce valuable programming to underrepresented groups. They cite that 190,000,000 Americans don't have access to the net at home, including most poor people and minorities. Almost no one has access to the net on a walkman, on a bicycle or in an automobile. They assert there will never be a substitute for the immediacy, interactivity, and local sensitivity of radio.⁵⁰

⁴⁹ <http://www.ntia.doc.gov/ntiahome/digitaldivide/factsheets/racial-divide.htm> as of 07/05/00

⁵⁰ <http://www.nlgcdc.org/handbook.htm> as of 07/05/00 ,

Yet as technology increases, there will be a substitute for radio. Looking at the great changes made in technology in the last decades, and the availability of the radio broadcasting on the internet already, there is no reason to believe that internet radio will not be the broadcasting medium of the future.

5.2 Recommendations

It is so important that engineers take a role of leadership in making such policy decisions. Engineers must work with policy makers to balance technical concerns and social needs. In the case of Low Power FM radio, I recommend that the companion bill to H.R. 3439, S. 2068, be passed as soon as possible, before LPFM licenses are distributed. In addition I recommend that the FCC look into new technology and mediums of communication to help groups which are underrepresented in today's broadcasting community to find their voice.

APPENDIX A

An Acronym Decoder

The following is a list of all abbreviations and acronyms used in report and a brief description where appropriate:

CEMA/CEA-formerly Consumer Electronics Manufacturers Association, now know as Consumer Electronics Association

EEO-Equal Employment Opportunity

FCC-Federal Communications Commission, an independent regulatory agency of the Federal Government which regulates many communications media including radio

LPFM-Low Power FM radio

MAP-Media Access Project

NAB-National Association of Broadcasters

NAS-National Academy of Sciences

NLG-National Lawyers Guild

NPR-National Public Radio,

NPRM-Notice of Proposed Rulemaking

OET-office of engineering technology, engineering and technology office for the FCC

SNR-Signal to Noise Ratio, see Appendix B

THD+N-Total harmonic Distortion plus Noise, see Appendix C

APPENDIX B

Signal to Noise Ratio

The ratio of the value of the signal to that noise

The SNR is usually expressed in terms of decibels

Value X in decibels found by taking $10 \log X$

SNR in dB can be expressed as $10 \log (\text{amplitude of signal} / \text{amplitude of noise})$

APPENDIX C

Total Harmonic Distortion plus Noise

Total Harmonic Distortion is the ratio of the root mean square (rms) value of the sum of the squared individual harmonic amplitudes to the rms value of the fundamental frequency of a complex waveform.

The root mean square can be found for a periodic function by taking the square root of the average of the square of the value of the function taken throughout one period

The rms of function y as a periodic function of time t is

$$Y_{\text{rms}} = \sqrt{\frac{1}{T} \int_a^{a+T} y^2 dt}$$

Noise is defined as unwanted disturbances superimposed on a useful signal that tend to obscure its information content, or an undesired disturbance in the useful frequency band

IN the OET study, THD + N was expressed as a percentage of the total signal.⁵¹

⁵¹ Booth, Christopher J. Ed. The New IEEE Dictionary of Electronics and Electrical Terms. Institute of Electrical and Electronic Engineers, Inc: 1370

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20 A Three Channel Adjacent Receiver Study, Jackson, Charles and Raymond Pickholtz, p.1

21 https://gullfoss2.fcc.gov/cgi-bin/websql/prod/ecfs/comsrch_v2.hts,7/18/00, as of 07/05/00

22 In measuring distortion in a communications lab, this is measure commonly used in personal experience

23 Interview with Mike Waring, Vice President, Government Relations, National Association of Broadcasters, 6/19/00

24 Translator, also referred to as repeaters, are stations which rebroadcast a station in a different geographical area

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