PUBLIC COMMENT REPLY

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of:	)**MM Docket No. 99-325**
	)
Digital Audio Broadcasting Systems	)
And Their Impact on the Terrestrial	)
Radio Broadcast Service	)
	)

To: The Commission,

On December 3rd, 2001, the National Radio Systems Committee (NRSC), sponsored by the National Association of Broadcasters and the Consumer Electronics Association, submitted a report from the Evaluation Working Group of the DAB Subcommittee of the NRSC entitled *Evaluation of the iBiquity Digital Corporation IBOC System , Part I – FM IBOC.*

By the public notice, issued on 12/3/2001 the Commissioners sought public replies to comments on the NRSC report, conclusions, and recommendations concerning the iBiquity hybrid mode FM IBOC DAB system, as well as on the iBiquity FM IBOC test results, with respect to the Commission's stated DAB policy goals and selection criteria.

In the NPRM dated November 1st, 1999, the Commission defined and stated as its policy goals for a new terrestrial Digital Audio Broadcast (DAB) service and sought comment on terrestrial in-band, on-channel (IBOC) AM and FM DAB systems and AM and FM DAB systems based on allocation of new radio spectrum in different frequency bands.

The Commission also stated in the NPRM its belief that it is necessary and appropriate to rely on some degree on the expertise of the private sector for DAB system evaluations, and listed the following 10 tentative selection criteria for DAB systems, including Spectrum Efficiency:

We Reply to the comments on spectrum efficiency raised by Cox Radio Inc. in their January 24, 2000 comments as follows:

4) The Spectrum Efficiency criteria are referred to and defined in paragraph 26, 27 and 28 of the NPRM dated November 1st, 1999 as follows:

26. *(4) Spectrum efficiency.* The Commission is committed to establishing a spectrally-efficient terrestrial DAB service. We recognize that certain basic design and regulatory trade-offs are inherent in all analog and digital systems. As Lucent observes, "there are multiple different pairings of attributes possible that would be capable of delivering digital audio in an IBOC configuration."[71] Lucent and USADR assert that IBOC is spectrum efficient in the sense of not requiring additional spectrum to implement digital transmissions. They also contend that IBOC would not encumber additional spectrum because the IBOC signal would be contained by the emission masks for the analog channels and has been developed around the existing analog interference protection criteria. However, spectrum efficiency as a selective criterion also concerns the additional value that results from the transition from an analog to a digital transmission service. In the instant context, the added value of spectrum is the product of several factors. These include the capacity of digital technologies to transmit greater amounts of data per hertz, enhanced flexibility, the ability to design digital systems that are less likely to cause interference, less susceptible to interference, and more robust with respect to multipath fading and non-radio noise sources, and the capacity to provide a listenable service at relatively low signal strength levels.

27. This proceeding also presents an opportunity to consider the spectral efficiencies that could be realized by advances in receiver technology over the decades since the analog interference standards were established. We note that analog receivers can now be designed with improved frequency selectivity to better reject potentially interfering signals on adjacent channels.[72] Although IBOC systems are based on existing analog protection criteria,[73] we wish to examine the extent to which state-of-the-art receiver technology may provide additional protection against interference, and thereby facilitate more intensive spectrum utilization. What

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[68] *LPFM Notice*, 14 FCC Rcd at 2490.

[69] *Id.* at 2492.

[70] *Petition*, Appendix D at 3.

[71] Comments of Lucent at 8.

[72] *See* Comments of Ford at 8.

would be the additional cost to consumers of receivers with state-of-the-art immunity? Are there design considerations other than cost that would practically limit interference immunity?

28. At this preliminary stage, it is clear that the Commission needs additional information about the specific mix of DAB design attributes that could best meet the current and future needs of *all* stakeholders in our free, over-the-air broadcasting system. Therefore, we seek comment on possible DAB spectrum efficiency standards. Are any of the Eureka-147 DAB and/or satellite DARS signal bandwidth and interference protection standards relevant in establishing DAB spectrum efficiency standards for IBOC and/or non-IBOC DAB systems? What bandwidth is necessary for DAB systems to achieve CD-quality audio signals? What are the spectrum implications of recent advances in coding and multistreaming technologies on the ability to deliver CD-like audio quality? With regard to each proponent's DAB system, what are the quantifiable trade-offs between bandwidth and signal robustness? What power, interference, and bandwidth trade-offs should the Commission consider in balancing the needs of incumbents and potential new entrants? Should there be different data capacity criteria during and after the transition to all-digital operations? Would the transition to all-digital service be slowed if incumbents were assigned less bandwidth for all-digital operations than their current channel assignments? Is preserving (or expanding) current AM and FM bandwidth assignments necessary for consumers to receive the full benefits of DAB, including a rapid implementation of an all-digital DAB system?

While some comments claim iBiquity IBOC would increase spectrum efficiency, we disagree for the reasons stated below:

The iBiquity system would reduce spectral efficiency, for existing users, of the fm band, while simultaneously degrading signal audio quality, and rendering unusable, some adjacent channels, especially in fringe areas and also, for users at the limits and outside the protected contours.

The Commission makes a serious error in assuming that the existing protected contours should be used for determining the impact of IBOC interference to existing FM users. The protected contours were never established with IBOC in mind.

Many FM users are located beyond the "protected contour" but still, with large investments in high quality, extra sensitive and extra selective receivers, routinely listen to distant stations.

The Commission Has FAILED to differentiate the effects of natural, and very likely short-lived, and probably random, natural interference, and IBOC's intentional, unnatural, and insidiously continuous interference, to these fringe area listeners.

IBiquity IBOC would ruin reception for these listeners, and simultaneously destroy the investments in superb listening equipment of these serious audiophiles.

The FCC should realize that in the fringe area, the –20db relationship of the iBiquity IBOC digital subcarrier would not be preserved as the analog subcarrier becomes limited in the IF amp, while the co-channel digital subcarrier does not become fully limited. In these situations, the digital noise will be presented to the discriminator, with only –0 to –19 dB (AM SNR), and without the usual AM noise rejection due to IF limiting.

The situation gets even worse, when an iBiquity digital subcarrier on a distant first-adjacent channel interferes with the analog carrier of another, desired distant FM station. Here, the IF agc does not even attempt to track. The IBOC interference could be completely unlimited , or only partially limited, while the desired analog signal could be fading in and out of limiting. The full AM IBOC interference would again be presented to the discriminator

Clearly, iBiquity IBOC REDUCES spectrum efficiency by simultaneously destroying the FM band's utility for existing users, and creating an excessively bandwidth limited, poor audio quality digital broadcasting system.

The FCC should establish three new frequencies for free, public, over-the-air terrestrial DAB radio.

In fact, the FCC Has already allowed XM radio to begin terrestrial DAB, on new frequencies in the "S' band! The rub is that it is not free over the air DAB..

According to "Phillip J. Brown, writing for Phillips Business Systems, about XM radio DAB:

> "The problem with SDARS (and S-DSB) is guaranteeing reception with an antenna the size of the palm of your hand," says Gambart. "To achieve this goal, you need a very powerful RF signal beamed toward earth. It has to be far more powerful than any other type of satellite for telecom, DTH, GPS, or MSS because the necessary throughput of the digital stream which is in the range of 1 Mbps to 2 Mbps combined with the limited reception characteristics of the terminal."
>
> "This is a unique feature. XM operates a big Boeing 702 with 17 kW of power with only two very high power transponders associated with two large 5- meter reflector antennas. To achieve this required performance, Alcatel has developed unique techniques to parallel up to sixteen 216 W TWTAs [Traveling Wave Tube Amplifiers] for XM with an active phase control feedback loop and a clever algorithm to configure the
> transponder in case a single tube fails or performs out-of-spec," says Gambart…..
>
> Boeing revealed that an anomaly impacting the performance of solar arrays on its 702's had been detected, and that this could impact the lifespan of satellites operated by several operators besides XM, including Thuraya, Telesat Canada and Panamsat. As mentioned earlier, the XM's S-band payload, which has been designed and developed by Alcatel Space Industries, uses twin sets of sixteen 216-watt TWTAs with six spares to drive a pair of transponders. The net result is approximately 2,800 to 3,000 W of RF signal power. XM has access to the upper portion of the FCC's S-band downlink allocation ranging from 2332.5 to 2345 MHz. . "This level of power is necessary to get through various blockages……
>
> XM estimates that it will cost more than $200 million to deploy its nationwide terrestrial repeater system in approximately 70 cities and metropolitan areas. In 1999, a contract was signed with LCC International Inc. for engineering and site preparation. That same year, XM signed another contract with Hughes Electronics Corp. for the hundreds of terrestrial repeaters necessary to fill any gaps in XM Radio's satellite coverage. "

So as you can see, the FCC has ALREADY ALLOWED TERRESTRIAL DAB TO COMMENCE IN THE "s' BAND! Due to the limited amount of solar array power and lifetime, even the big Boeing 702 platform may not have the desired satellite lifetime

The XM "S" band DAB system, therefore needs still more power, and thus terrestrial repeaters!
This is due to the higher power demands in lossy, urban areas, and while the XM service claims only a temporary need for these repeaters, they are quite likely to become permanent.

The Commission should create separate new broadcast bands for digital broadcasting like Britain's 220 MHz Eureka-147 and Canada's L-Band 1452-1492 MHz DAB.

The existing FM band analog broadcasting should be preserved for analog FM and analog LPFM community radio.

The "S" band DAB system, needs still more power, and thus should be opened to free over the air broadcasting for local content terrestrial repeaters, as well as new content and public service providers!

The FCC should create a NEW terrestrial band III, near 220 MHz, like in Great Britain (Eureka-147) and a NEW terrestrial band IV (L-Band) -DAB Eureka-147 service, and a new band V "S" band terrestrial free over the air Eureka-147 DAB service, shared with the existing satellite DAB service to provide that service local content and additional free content.

The new services should have adequate bandwidth to accommodate DDSS (Direct Digital Signal Synthesis). In these bands, adequate bandwidth exists, to allow Software Defined Radio. These bands, unencumbered by historical subcarrier assignments, have the potential for SDR with downloadable codec SDR (Software Defined Radio) operation.

This would allow for future codec improvements to be automatically downloaded on the new Band III and Band IV, and Band V while preserving the existing analog bands. These new, free, over-the-air radio broadcast systems would augment, rather than destroy existing FM (and AM) band broadcasts, and provide adequate bandwidth, to allow for reasonable expansion of access, for Americans, to vast new entertainment choices.

The ill conceived (apparently as an illegal spectrum grab), ibiquity system, in contrast, would destroy existing broadcast bandwidth resources and perpetuate, and exasperate, the lack of consumer choices in broadcast radio. The iBiquity IBOC proposal would do this by introducing excessively wide bandwidth for reduced audio quality and coverage range, and a fixed yet undefined and soon to be obsolete codec scheme, and inappropriate ancillary services, thus stealing bandwidth from other legitimate FM users.

The FCC errs in assuming IBOC would be of any value to the public interest. In fact, it is quite contrary to the public interest.

There should be no transition to "all digital broadcasting" on the 88-108 MHz FM band, as this would destroy a large public investment in inexpensive, proven receivers, and force the public to purchase very expensive digital replacements.

Should the Commission insists on inappropriate conversion of the existing FM (or AM), then the public MUST have plenty of advance notice.

The FCC should have, reasonably, learned from the FCC's Digital TV fiasco, that the public does not intend, nor should it be required to write-off large investments in existing analog systems. The public should not be forced by FCC fiat, to replace it's very large analog equipment investment with digital.

Such inappropriate, last-minute mandates are sure to enrage the public. The public has not been given twenty five years advance notice of such changes, as they must, to reasonably decide what to purchase, if anything.

Such last-minute broadcast restructuring destroys well-developed analog equipment markets, and the FCC would be very wise avoid doing so. The FCC should not embrace or promote an inferior and audio bandwidth limited system like iBiquity IBOC.

The public deserves advance notice of at least about twenty-five years, for such a radical change as IBOC (or HDTV's FCC mandated cessation of analog TV broadcast in 2007 for that matter).

FCC should have required stickers on all analog TV sets sold after 1982, telling the public "If you buy this device it will no longer function after (2007). The FCC, in its haste to promote the interests of the NAB and the manufacturers, failed to do so. And the manufacturers would have protested in any event. Such a notice would have damaged TV sales from 1982 through 2007.

The FCC should recognize that the public deserves 25 years notice. This would then require that the FCC should require a sticker, should IBOC be adopted, advising consumers who purchase analog FM radios, that: "The FCC intends to mandate discontinuance of analog FM broadcasting in 2027(or 25 years hence) and this device will not function after that date.

The FCC should understand that less than twenty five years notice is inappropriate. Since 1975, virtually all TV receivers have been solid state. Many viewers are still watching the first solid state TV they ever purchased in the early seventies. Since vacuum tubes went away, solid state analog receivers have a twenty-five year average life expectancy.

The FCC should not meddle in the marketplace.
The public is not clamoring for FM (or AM) analog bands to go away from their existing radios.
The public wants more choices in free over-the-air radio, and that means additional bands.

If analog FM (or AM) goes away, the public, in the marketplace, should make that choice, not the FCC, not the NAB, not the NRSC, and not the manufacturers.

The FCC needs to stop being so stingy with broadcast opportunities for free over the air broadcast radio Bands for Americans. We trail the world in that regard.

Since the 1950's when Sen. McCarthy held his now discredited hearings, even our short wave bands disappeared. The FCC no longer allows Americans to broadcast free over the air radio to other Americans on those bands. We hold out our free speech sacred to others while our own government prohibits it for us!

The FCC should create three new bands for free over the air DAB radio compatible with Eurika-147 and also permit others to use the "S" band for free over the air terrestrial DAB with public service and local content.

If the content is then desired by the public, then the public will choose to purchase the new five band radios, instead of the existing two band radios. The public would decide, as it should, in the market place, and without the shotgun of a FCC or NRSC fiat!

The public would make the choice to let analog FM (or AM) fall into disuse, and write-off their investment.

That is the proper way.

If the public makes the choice to write-off analog FM (or AM) then in due course, the now publicly abandoned frequencies could then be re-used for other purposes. This could ensure a speedy public acceptance of DAB on the two new bands.

The proponents of iBiquity IBOC should not be allowed to meddle in the marketplace with the FCC's blessing, as was done with the "Digital TV" fiasco.

The proponents of iBiquity IBOC, should understand that their attempt to commandeer additional spectrum for ancillary, non free over-the-air public broadcasting will only hurt the public acceptance of DAB in general, and delay it for many years.

The iBiquity IBOC proponents would be wise to withdraw their embarrassingly transparent spectrum grab proposal. And petition the FCC to embrace a Band III and Band IV proposal that really does have the potential to increase audio quality and enhance public choices.

Furthermore:

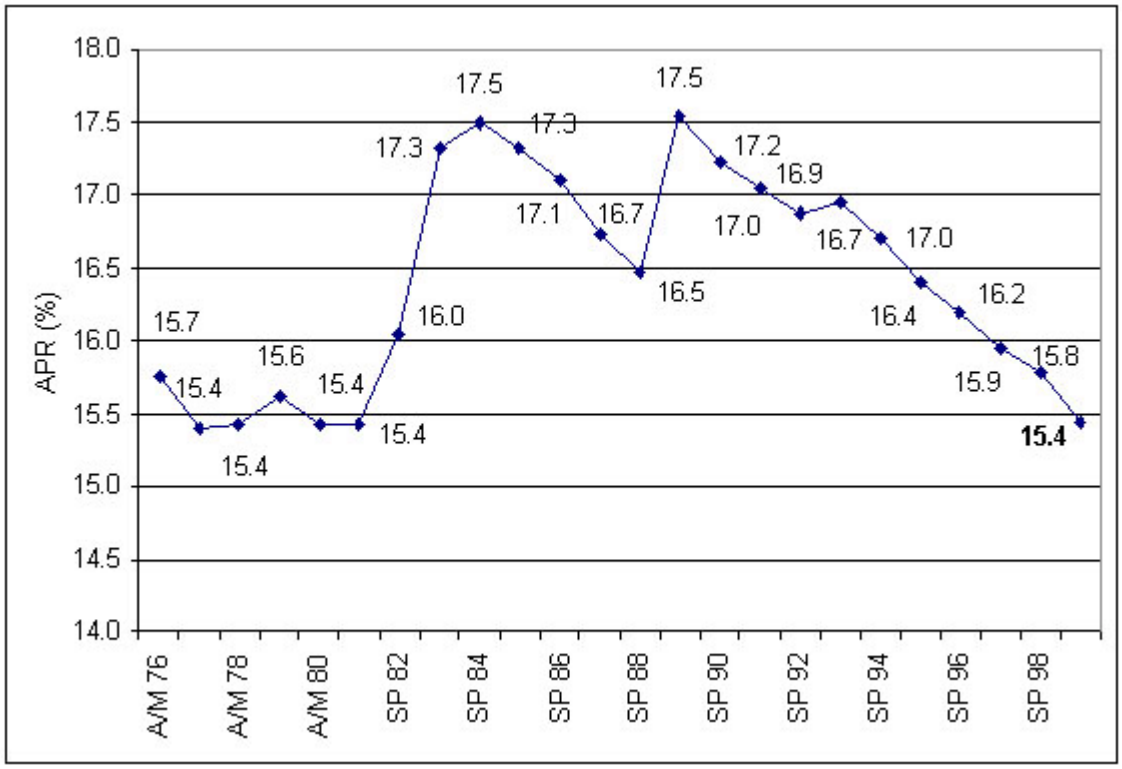
Several commenters state that they are the best ones to handle a transition to digital and that they should get the digital to help them compete with Internet and Satellite.

VCPP comment replies that the function of the FCC is to serve the PUBLIC INTEREST and not to serve as a protection racket for established businesses at the expense of new businesses. When FM became available in the 1940s, the FCC did not operate on the assumption that AM broadcaster were the ones best qualified to receive a one to one replacement on the FM dial of their AM stations. Broadcasters were expected to simply apply to build an FM station or not, as was their private decision.

The unchallenged assumption that broadcasters are entitled to a one-to-one replacement of their analog station with a digital station is simply the worst kind of Corporate Welfare, a 21st century equivalent of the Divine Right Of Kings. The argument above suggests that existing broadcaster are to be the only ones deserving of access to the public's resources. This is circular argument. It cannot be assumed that they are the best for the job because they are already there and they are already there because they are the best ones to use the resource. By this argument we would still be a colony of English Kings!

But studies show that what people really want is GREATER VARIETY OF CONTENT and LESS ADS which is achieved with more diverse ownership of more channels and not with allegedly greater sound quality.

iBiquity and Visteon both comment that there will be some loss of listenership for a station in its fringe areas. Thus IBOC will actually ACCELARATE , public abandonment of the FM and AM broadcast bands in favor of SDARS and Internet MP3 or RealAudio compressed streaming audio sources that have greater variety and less ads (see Sony comments 1/24/2000)
See also the M-Street report on loss of listenership which is graphic and text below.



SOURCE : Chart by Tony Sanders of *Duncan's American Radio*.
Text: Tom Taylor of M Street.

(NOTE: First published in the 8 December 1999 edition of *M Street Daily,* Author Tom Taylor quoting Jim Duncan):

> "Yesterday we told you analyst Jim Duncan's twin worries: 'The way we treat our advertisers and the fact that an increasing number of our listeners are going away.'
>
> Do you doubt they're going away? Here's a just-released 23-year *Duncan's American Radio* chart of mean APR (average percentage of the 12+ population using radio in any quarter hour, 6 AM to midnight). The entire decade of the 1990s hasn't been pretty, 17.5 to 15.4 (see chart above) equals a 12% decline.
> At Monday's Paine Webber confab Duncan called it 'historically a huge decrease.'
>
> Villains? Higher spot loads (maybe 20+ units an hour), more canned programming and a lack of programming innovation. Solutions? Jim Duncan Prescribes a 'commitment to localism' – 'Local operations, local research, local programming decisions, local promotion, local news and events.'

In 1999 [page5 and 6 of FCC NPRM November 1st, 1999] CEMA found that IBOC "exhibited two major deficiencies: (1) poor digital audio performance under impaired signal conditions and (2) incompatibility with analog FM service."

In light of the prior history of IBOC's failures the FCC should impose a greater burden of strict proof that the situation has now changed through objective technical testing by disinterested parties.

So far, the vast majority of the tests have been performed by parties with conflicts of interest.

There is a conflict of interest because the same folks testing the technology own the company that makes the technology and they are all on the same board of the NAB that is supposed to coordinate testing and

comments about said tests. Historically these represent the same parties with the same conflicted interests who have previously failed to demonstrate IBOC's technical superiority or compatibility with existing FM Broadcast services.

The FCC is abdicating its regulatory and testing authority and responsibility to private interests. The FCC should require or perform independent testing and refuse to allow the NAB and the NRSC to substitute their self-interest which can only conflict with the objectivity of technical testing program and data.

To correct this, the FCC should require that iBiquity fund either independent testing or rigorous testing by the FCC itself using objective test criteria rather than subjective tests.
[iBiquity claims on PAC (Feb 12th?) that "expert listeners" were used in the testing, but iBiquity fails to elucidate what objective test would be used to determine who is an "expert critical listener."

No information was provided as to the occupations of the so-called expert listeners of the tests of PAC sound quality.

Certainly the art and science of audio engineering has always required that we strive for concert hall realism. Yet the entire thrust of the PAC expert listening tests were to strive for a "close approximation " to the 30 year old "CD standard" rather than the concert hall realism

In the NAB's reply-comment dated 3/21/02 to the Virginia Center for Public Press's (VCPP) previous comment in the instant case we respond the NAB notes that in the VCPP comments that we misrepresent the subjective evaluation portion of the NRSC testing process, the VCPP replies that we have made no suck misrepresentation. Contrary to what is stated by the NAB in its reply 3/21/02, we stand by our previous comment where we stated,

> "[w]e note the advanced age of the fifty-five subjects, attending an NAB convention (an inappropriately composed test group probably more likely to represent the broadcast interest advocacy position, than a neutral or skeptical position),"

We respectfully reply that the NAB has never contacted us with respect to their concern that VCPP may have misrepresented the nature of the subjective evaluation portion of the NRSC testing process.

We respectfully suggest that the NAB reasonably should have attempted to clarify this issue before asserting an unfounded allegation that we misrepresented the NRSC testing process.

Contrary to what is stated by the NAB in its false accusation of misrepresentation, we believe that we correctly quoted appendix K of the December 3rd 2001 report by National Radio Systems Committee, section entitled ***Appendix K NRSC Industry Subjective Evaluation*** which is on page 188 of that report and duplicated on the next below. (without the original table formatting and the graphic but with no changes to the text).

The VCPP points out that the NAB has apparently failed to read and comprehend page 188 of its own NRSC's report dated December 3rd, 2001.

We merely noted the advance age of 55 male subjects referenced in appendix K.

Since there was only one female subject, we excluded her from our comments in regards the age of the participants but noted the lack of additional female participants.

see page 188 of the December 3rd 2001 report by National Radio Systems Committee, section entitled *Appendix K NRSC Industry Subjective Evaluation* reproduced below

Appendix K NRSC Industry Subjective Evaluation

" November 7, 2001
To: NRSC Evaluation Working Group
From: iBiquity Digital Corporation
Re: FM Industry Evaluation
Attached to this memorandum are the results from the NRSC FM Industry Evaluation
conducted September 5-7, 2001 at the NAB Radio Show in New Orleans. Sixty-one
participants were trained, screened and tested. Of these 61 participants, 3 were excluded
for failing the screening test, and 2 were excluded for not finishing the experiment. Thus,
results from 56 participants are reported in the attached NRSC Industry Evaluation
Performance and Compatibility Tables. Fifty-five males and 1 female participated.
Table 1 is a breakdown of participants by age.
Table 1: Breakdown of participants by age

18-29	1
30-39	14
40-49	27
50-59	17
60+	2

Jennifer Devlin and Ellyn Sheffield of iBiquity conducted all training, screening and
testing. All methodological practices used at Dynastat during the FM Test Program were
followed as closely as possible, including method of presentation, analysis of screening
results, and preparation of results (i.e., tables with confidence intervals).

A subset of the sound samples evaluated at Dynastat in the overall subjective evaluation
program was compiled for the Industry Evaluation. Samples were taken from the field
performance, field compatibility, lab performance and lab compatibility portions of the
test program. No SCA audio samples were included. Samples were divided into three
experiments, leveled and presented to participants over Sennheiser headphones. Data
from all experiments were combined for analysis after testing was completed."

The VCPP notes that the test group was described in appendix K as attendees at the NAB radio show in New Orleans. Now the NAB asserts that the participants were consumers from the Austin Texas metropolitan area. The VCPP questions whether the transportation for these hand-picked test subjects with a gender and age peculiar distribution was paid for by the iBiquity, NAB, NRSC or any of the other interested partners. Why were these participants selected and transported to New Orleans unless they were prescreened and found to be a suitably composed test group to provide a desired result.

The VCPP reiterates its position that this was a poorly assembled group of test subjects. We also state that the VCPP is fully aware that the subjective test for the Perceptual Audio Coding system, such as used in the iBiquity system are subjective by design because perceptual audio coding relies on the psychoacoustic perception peculiarities of the human auditory system, such a poorly assembled group of test subjects with skewed age distribution and lack of female hearing response is highly inappropriate and outside the realistic scope of meaningful subjective perceptual audio testing. The NAB fails to recognize the well known fact that these subjective measurements offer far less insight into the performance of high quality audio reproduction.

The VCPP further notes the failure of the test group selection criteria to define any objective standard for what constitutes an “expert listener”.

The failure of NRSC to include sufficient data in appendix K for the reviewer to discern the occupation or expertise of the so-called “expert listeners” reveals the extremely poor quality of the work.

Such test results cannot be relied on both because the data is purported to be extracted from so-called “expert listeners” but testing methodology fails to provide any genuine criteria for expertise and because the science of perceptual coding itself is suspect because of highly variable individual hearing perception.

The NAB should be more interested in the advancement of REAL excellence in audio, instead of the advancement of the so-called “improvements of the so-called science of psychoacoustic noise masking technology masquerading as genuine audio quality.

The NAB’s NRSC’s intense interest in the ability to deceive the mediocre listener by substituting apparently good sounding audio in a manner that is likely to be indistinguishable from the real thing is deceptive.

Contrary to the assertions of the NAB that the VCPP fails to recognize the well known fact that subjective tests are appropriate, by design, for the proper measuring of perceptual audio coding system performance, we disagree that subjective test criteria is appropriate.

While the VCPP is fully aware of the attempts of some, including iBiquity, the NSRC and NAB to pass psycho-acoustic noise masking off as real audio science, the fact that subjective testing is deemed desirable is ample evidence of it’s status as junk-science.

The position of VCPP remains that only objective measurement criteria and test methodology are appropriate.

We do not deny that psycho-acoustic effects are interesting and real, but since they are highly variable from individual to individual, they have no place in the formulation of a new broadcast standard, and should never be relied on for alleged signal-to-noise ratio improvements.

Further, we do not deny that many people do hear interesting psycho-acoustic phenomenon, such as noise masking, and surround sound that can enhance the listening experience. But each subject’s audio response is different, and the deception is often most rejected by genuine audio “expert listeners” such as musicians and audiophile purists.

The VCPP is fully aware that the subjective testing methodologies that have been widely reported to be appropriate.

the fact that by design PAC performance cannot be measured by objective measures such as

So in the FCCs requirement for double blind objective studies , the FCC should specify that the expert tests subjects be comprised of true experts such as concert hall musicians, recording engineers, concert hall audio engineers, and others who are truly experts in creating faithful audio reproductions that are as equivalent as possible to actual concert hall renditions.

We should not settle for marginal or incremental quality advances in the recording sciences when the true requirement should be to make a substantial increase in our ability to reproduce concert hall realism with the new DAB system.

Ibiquity, in it's inappropriate selection of audio quality goals, has settled for a jettisoning of the singular goal that has always defined the art and science of sound reproduction since Thomas Edison's time! IBiquity has chosen to dumb-down the goal. They are trying to faithfully reproduce the sound of the 30 year old CD codec, rather than striving to faithfully deliver the sound of the concert hall piano, orchestra, or vocalist. Historically, Armstrong devoted his life to recreating concert hall realism for his new FM radio system.

The FCC should recognize that it is complicit in this dumbing-down of the universal and singular historical goal of those who are practiced in the arts and sciences of delivering excellence in sound reproduction.

In it's NPRM, the FCC itself seems all too willing to jettison the historical goal of excellence in sound reproduction, and simply settle for "Near CD quality"

The NRSC is sponsored by the NAB and CEA; both of whom will directly profit.

- AND NAB is formed of mainly the largest broadcasters and manufactures.
- AND the SAME developing conglomeration of broadcast companies amounting to a monopoly that owns iBiquity
    - THUS it is a worthless exercise in cheerleading to have those companies that own iBiquity
    - AND are members and funders of the NAB
    - WHO funds and empowers and directs the NRSC that allegedly tests IBOC
    - TO find that the NRSC finds and comments that IBOC is wonderful and will not damage the smaller broadcasters who are NOT owners of iBiquity, members of the NAB and are largely UNAWARE of this proposal !!

Furthermore we therefore also conclude that the FCC should consider all commenters that have common membership, ownership and financial stake in outcome, such as the NAB, NRSC and iBiquity to be considered a conflicted special interest group and require strict proof and independent testing and confirmation of their so-called test results. Their input should be given diminished weight because of their conflicted self-interest and the primary weight of the public and independent testers who have no financial stake in the iBiquity technology.

A reading of many of the commenters shows them to be nonresponsive to the questions and function largely as a headcount of cheerleaders of the same interest group.

The NRSC is comprised of the same folks who test AND manufacture it and are replacing the FCC!

We should require the NRSC to hire independent testers chosen by the OPPONENTS of IBOC.
The MORE PROPER method is for the FCC to do its OWN testing. If not, then the FCC should select independent testers in a similar manner that juries are chosen for a court case. Both the PROponents AND OPPonents should be involved in choosing the testing committee members and testing institutions to verify that the testing methodologies meaningful.

EXAMPLE: On 2/19/02, iBiquity has on page 5 of Appendix B a chart (see below) showing that the Mean Opinion Score for Classical Music, Solo Vocals and Speech is higher, after being processed via a compressed IBOC audio stream, than the original source "CD Quality" wave files !!

It is internally illogical as well as inconsistent with the “accepted audio wisdom” stated throughout these tests that a reference should be the highest quality sample available. Clearly, this result must be a result of the shortcomings of the subjective nature of the so-called perceptual audio testing.

Of course the more likely case is that the differences are within the margin of error of the survey instrument and are thus statistically irrelevant.

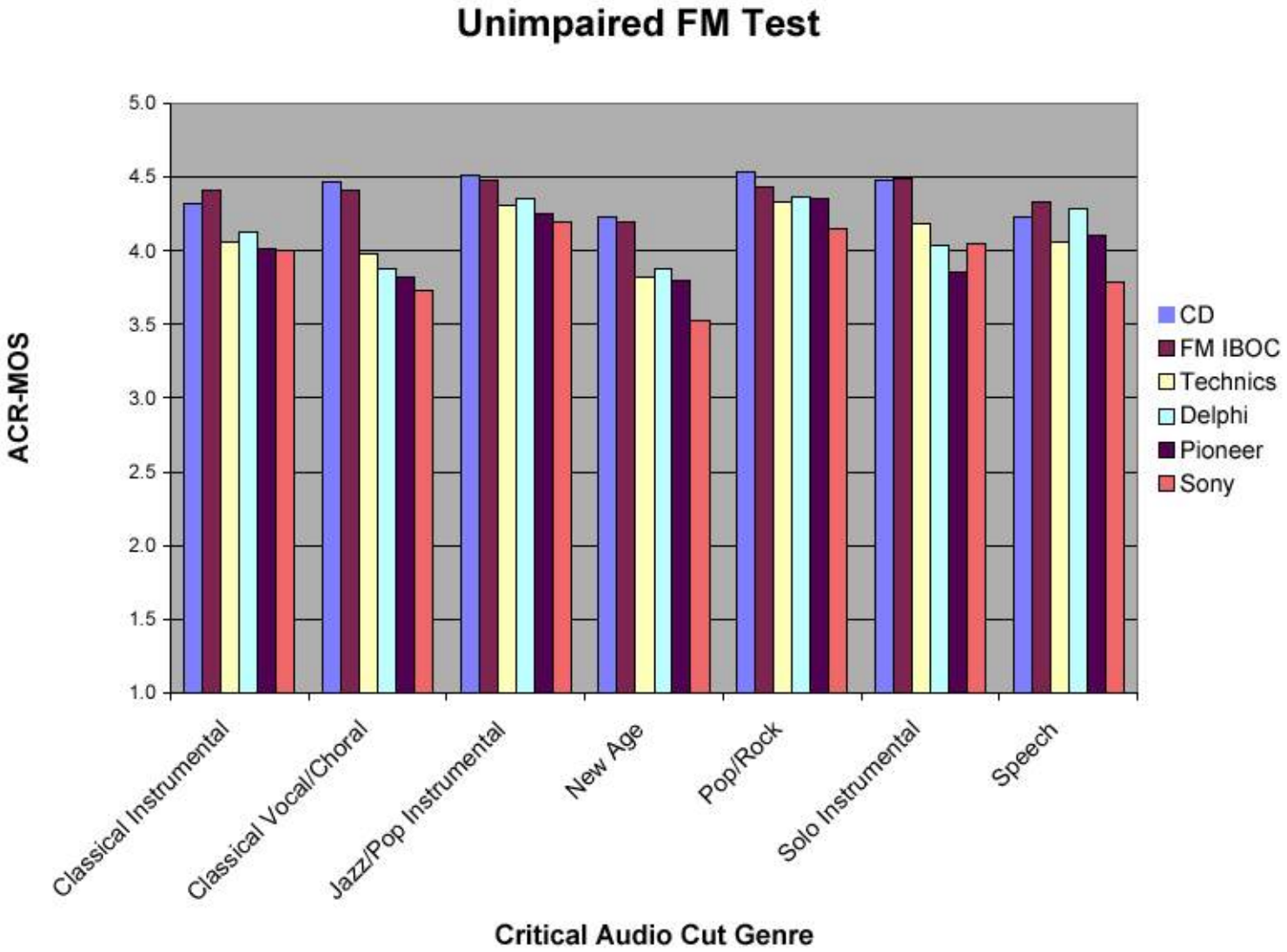


Figure 2 – Audio Quality Results by Genre

SOURCE: iBiquity 2/19/02 Page 5 of Appendix B in docket 99-325

EXAMPLE: iBiquity maintains that the spectrum efficiency is improved and that similar or greater coverage is achieved. Then we see in this test (See Fig 5 below) that WETA digital range was LESS than the analog range.

Visteon (page 3 of Visteon's 3/15/02 comments) Comments:

> "IBOC coverage was roughly 70% of analog coverage if analog coverage is assumed to include fringe areas where high-performance radios, such as typical automotive radios, will have some audible noise and/or interference due to lower received signal levels."

The below graphic of WETAs coverage is WITHOUT any adjacent IBOC stations next to WETA on the FM broadcast band located anywhere in the geographic areas covered in the test. Thus it is internally inconsistent to state that WETA's fringe area was achieved by the analog radio WITHOUT any competing IBOC sidbands to disrupt it!

This is in the same report where iBiquity admits that sidebands will harm fringe analog reception that WETA relied on for the full range! We also therefore don't know what happens to an IBOC receiver when its target station is surrounded by two other IBOC sidebands on both sides.

For example, in iBiquity 2/20/02 comment, attached document entitled *Document No. 02-08B Digital Audio Broadcasting – Performance of the iBiquity Digital FM IBOC System in Unimpaired Channel Conditions* Page 5

> "The sum of *all* digital carriers in the hybrid signal has an *average* power that is 20 dB less than the average analog power."

So it could easily be only 14dB less in a real-world situation with two adjacent IBOC sidebands impacting the analog to which you are supposed to "blend to".

The situation could be even worse after passing through the IF strip and prior to the discriminator which could see considerable AM.

Our real world test did indeed confirm this.

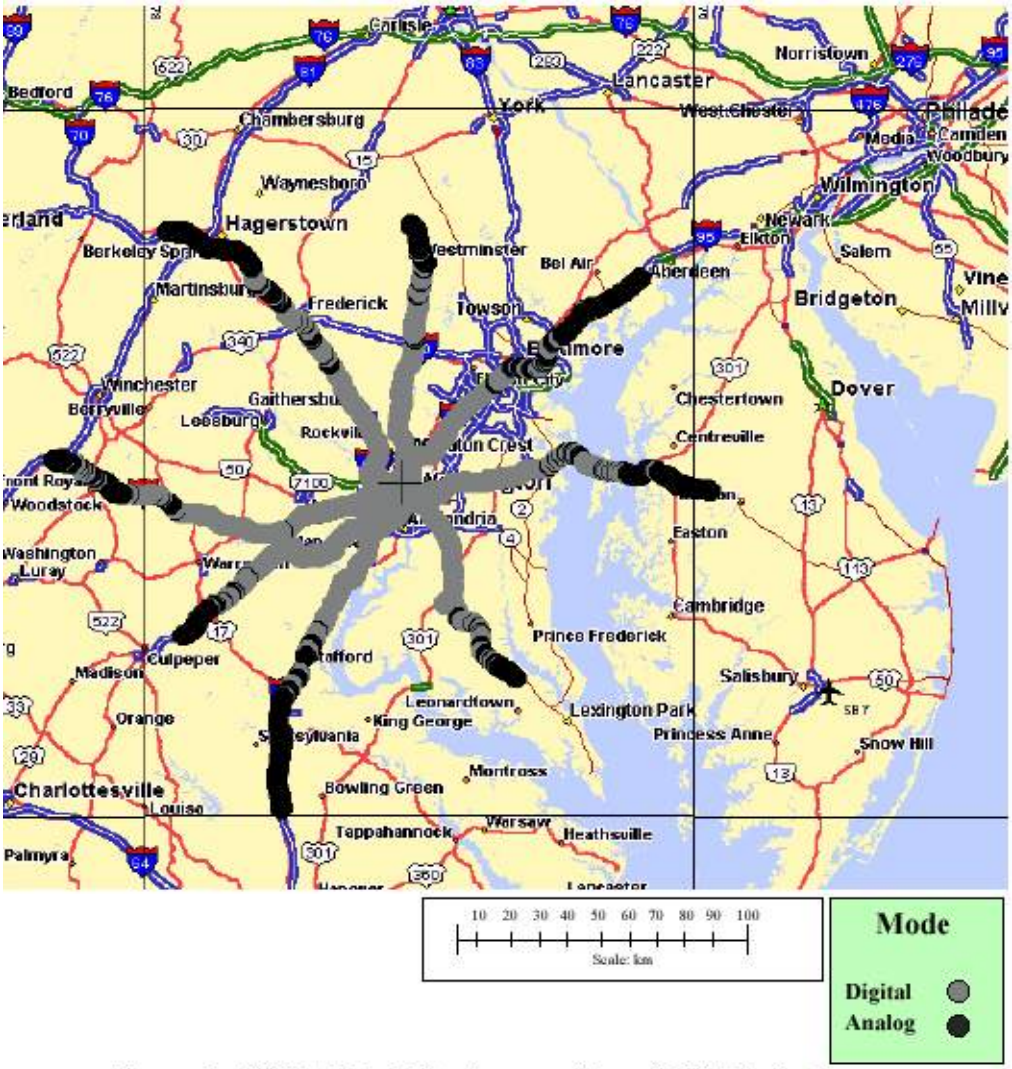


Figure 5 – WETA Hybrid Performance (from NRSC Testing)

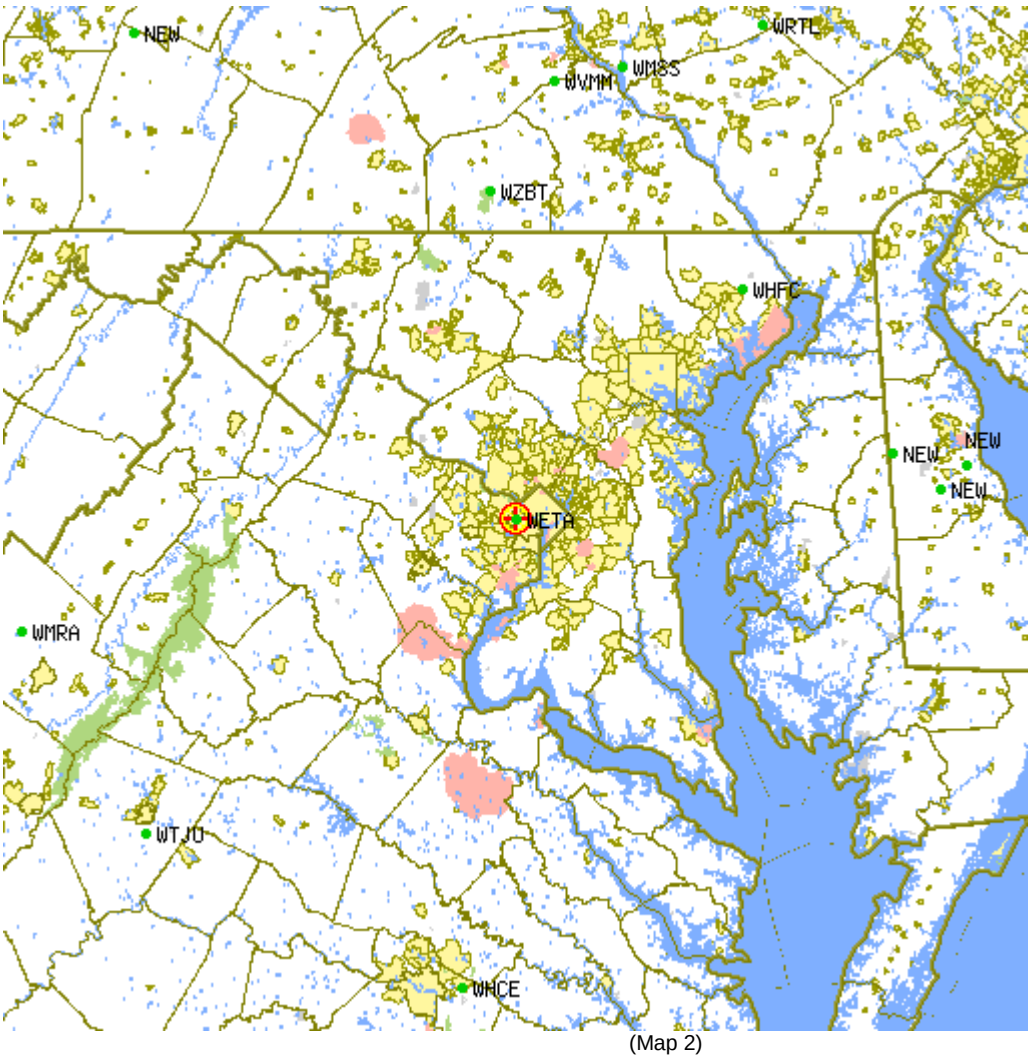
(Map 1)

Source: iBiquity 2/19/02 Page 7 of *FM All-Digital IBOC Field Test Report* dated Feb 1st, 2002:

Since some portion, often probably half of the digital carriers are off at any one moment, this means that an average means that often there will be bursts of IBOC digital carrier energy that is only 10dB or less down from the Analog Host. As the person trying to pick up WETA approaches WETA's fringe, the IBOC *and* the analog "blend to" receiver will begin to experience interference from the adjacent to WETA around it visible as small green dots on this map and listed in next table:

Station Summary Report

Freq MHz	Call	Svc	Cl	Pol	Dir	HAAT m	Power kW	Dist mi	Heading		Location
90.7	WVMM	FM	A	H=V	omni	50	0.100	88	5	n	US PA Grantham
90.9	WETA	FM	B	H=V	omni	186	75.000	0	226	sw	US DC Washington
91.1	WHFC	FM	A	H=V	omni	69	1.100	65	44	ne	US MD Bel Air
91.1	WZBT	FM	A	H=V	omni	116	0.180	66	355	n	US PA Gettysburg
91.1	NEW	FM	A	H=V	Dir	66	3.300	76	79	e	US DE Dover
91.1	NEW	FM	A	H=V	Dir	53	2.000	85	85	e	US DE Felton
91.1	NEW	FM	A	H=V	omni	43	4.200	91	83	e	US DE Camden
91.1	WMSS	FM	A	H=V	omni	-21	1.350	93	13	nne	US PA Middletown
91.1	WHCE	FM	A	H	omni	32	3.000	94	186	s	US VA Highland Springs
91.1	WTJU	FM	B1	H=V	omni	325	0.600	96	229	sw	US VA Charlottesville



(Map 2)

If a proper test were done on the Virginia-DC area, an entire cluster of stations should be operated with IBOC sidebands from DC to Central Va. and Norfolk for all stations from WCVE88.9, WPFW 89.3 to WHRV89.5 and WAUQ89.7 and WJYJ 90.5 especially including the small stations such as WDCE 90.1FM. All these stations would have to run announcements at the top and bottom of every hour informing their audience of the IBOC tests and whether at that moment the sidebands were OFF or ON. The schedule for the on and off status of the IBOC sidebands would be announced ahead of the time of the tests in the legal announcement sections of all major newspapers in the affected areas. The announcements would give a phone number of a third party such as the Benton Foundation or Fairness And Accuracy In Reporting to track the experiences of the public. The announcements would also actively encourage the public to call those numbers to give feedback and to get a survey sheet for more detailed questioning such as what kind of radios were used at what locations at what times and what the sound quality rating using the same Mean Opinion Score system.

This would provide a rich opportunity for full public interaction and real-world tests of all aspects of IBOC interaction in the real world such as the effect on the range of WDCE90.1 under the dual IBOC sidebands of WAUQ and WJYJ as well as co-channel for WCSP90.1 and WDCE90.1FM. This will also provide an opportunity to test the effect of a "satellator" with "vertical only" polarization such as WAUQ89.7FM and to see what effect IBOC for both WHRV89.5 as well as WAUQ89.7 has for listeners in towns in-between such as residents of Williamsburg Virginia.

The third party (such as Benton Foundation) will then be funded by FCC funds to mail the findings of this survey to ALL broadcasters and applicants for broadcast license including LPFMs and translators and anyone who requests it.
The findings will also be posted to the web.

This will help resolve the problem of whether adjacent stations are interference risks or not!

A Timeline of Inconsistency

In 1996, The NAB in docket 96-120 vigorously defended short spaced third and even second adjacent full power stations and translators such as WJFK106.7FM at 22,500watts and WQRX107.3FM at 34,000 watts *only 9 miles away!*

Then in 1998, proponents of LPFM requested that they be able to *also* enjoy the advances in receiver technology such as PLLs cited by the NAB in 96-120 that allow those stations so powerful to stay where they are without difficulty. The NAB said that it defied the laws of physics that adding third adjacent 100 watt LPFM stations to the FM dial was not going to cause interference.
The NAB said that LPFMs would harm the ability of stations to reach fringe listeners.

Then in 1999, the NAB essentially argues that adding energy to the FM dial's FIRST ADJACENT frequency is not an interference threat and *discounts the value of fringe listeners.*

NRSC and IBOC 's TESTING FAILS TO MODEL PROTECTED COUNTOR INTERFERRENCE PROPERLY

The Virginia Center for a Public Press, hereby submits it's reply comments based on our real world independent IBOC interference test measurements, a our predictive interference mode methodology The results reveal that iBiquity IBOC system falls far short of the proponent's purported testing claims.

While VCPP has been doing it's independent testing and modeling on a "shoestring" budget, we believe the tests we conducted and modeled clearly reveal the fallacy of the FCC's reliance on the testing procedures developed and carried out by the NRSC and IiBiquity.

The FCC should not consider the NRSC IBOC testing to be objective. NRSC is hardly an objective testing organization, instead, it is a creation of the NAB and it's own broadcast equipment manufacturing membership.

The FCC should not consider iBiquity IBOC testing to be objective IBiquity can hardly be considered objective either, since it is a merger of Lucent and USADR. IBiquity's Strategic Partners are:

Broadcast Transmission Equipment Manufacturers

- Harris Broadcasting
- Broadcast Electronics
- Nautel
- Continental Electronics
- Armstrong Transmitter
- QEI Corp.
- Energ-Onix Broadcast Equipment

Broadcasters

- ABC
- Cox Radio
- Emmis Communications
- Entercom Communications
- Hispanic Broadcasting
- Radio One
- Beasley Broadcast Group
- Bonneville International
- Clear Channel Communications
- Infinity Broadcasting
- Citadel Communications

Cumulus Media, Inc.
Saga Communications
Regent Communications

Receiver Manufacturers

Alpine Electronics
Delphi
Hyundai AutoNet
Fujitsu (10) Ten
Sanyo Electric Co., Ltd.
Visteon Corp.
Bosch/Blaupunkt
Clarion
Harmon Kardon
Kenwood
Jenson
JVC

SemiConductor Manufacturers

Texas Instruments
Philips Semiconductors

Retailers

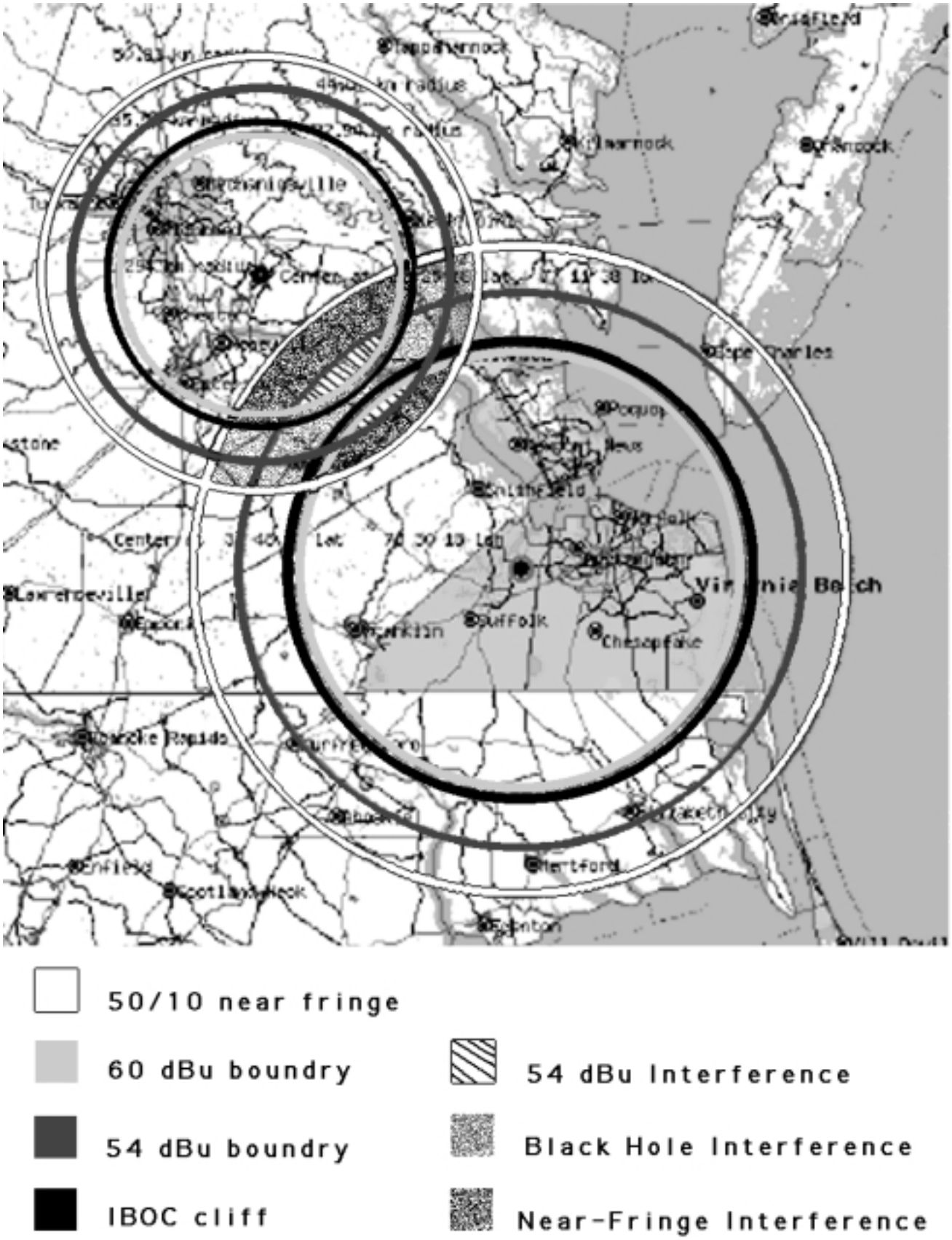
Crutchfield

In addition, the VCPP urges the FCC to conduct it's own engineering studies to settle the apparent failure of iBiquity and the NRSC to fully document the co-channel and adjacent channel interference problems associated with iBiquity IBOC that were so obvious in previous iterations.

Additionally VCPP finds the so called "Perceptual Audio Codec" to be an inferior CODEC and further the VCPP finds the FCC stated goal of achieving "Near CD audio Quality" insufficient for providing a worthy advancement of the recording arts.

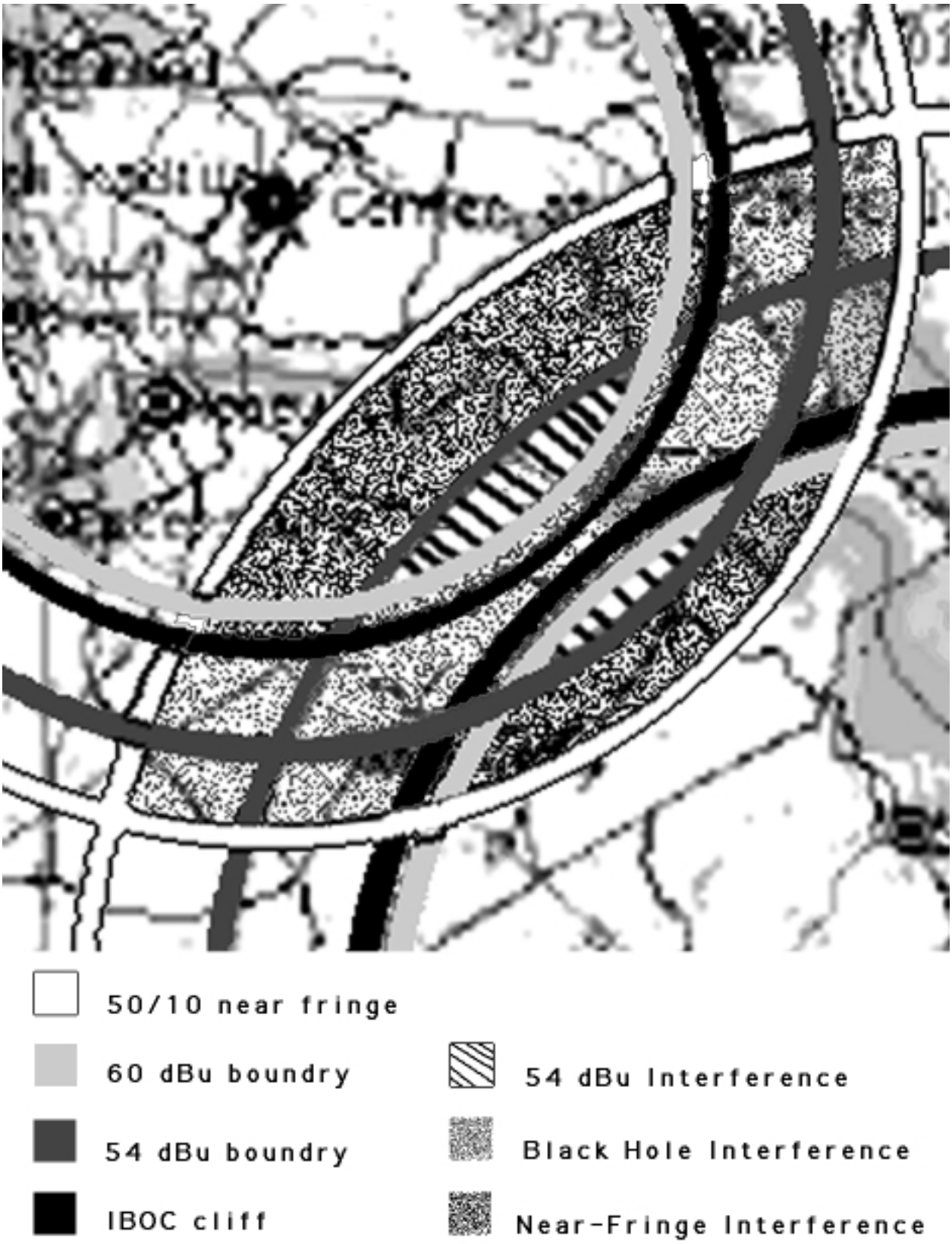
THE VCPP's INDEPENDENT ADJACENT CHANNEL INTERFERENCE MODELING

The VCPP is pleased to offer it's independent IBOC testing and interference modeling results to the FCC. We stand ready to pursue further independent IBOC testing and urge the FCC to provide, or order the proponents to provide funding to independent testing organizations such as ourselves or other similarly situated organizations to provide additional independent testing information to the FCC.

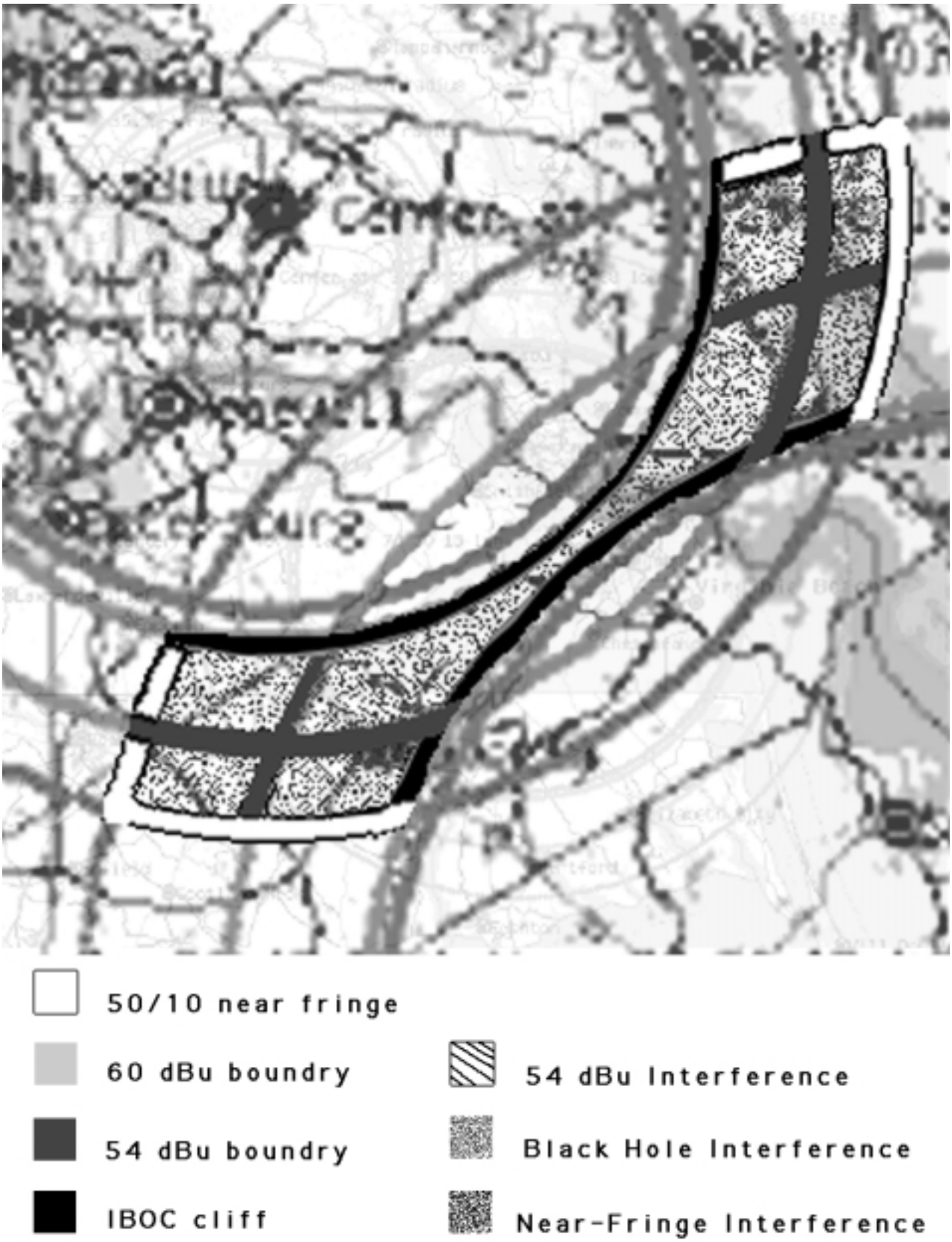


(Map 3)

This Map reveals several different intersecting areas, each with its own distinct type of IBOC generated interference which will be explained in detail below.



(Map 4)
This Detail Inset of the overlap areas reveals the several types of interference in greater detail. Each will be separated out and commented on below.



(Map 5)

In this saddle-shaped area we find we are beyond the “IBOC cliff” for both stations. So a DAB radio would receive neither station in digital. Nor could the radio receive either station in analog because of the combined adjacent channel sideband interference which would prevent a blend to analog for either station. We refer to this area as “The Radio Black Hole Zone”.

(Map 6)

In these areas, near-fringe listeners who could formerly hear both stations on the adjacent channels can now hear neither in analog due to the now co-channel interference from the IBOC sideband of the other IBOC station. Note that at these distances reception is common although not protected.

(Map 7)
On these maps, the 60dB contour boundary and the IBOC cliff contour boundary nearly coincide. However the slashed areas show regions of the 54dB boundary which would be protected for an educational station being interfered with by an adjacent channel transmitting co-channel IBOC sidebands.
So this is an example of a protected contour interference situation well within a protected listening area.

Source: Created by VCPP to illustrate WAUQ89.7FM damaging reception of WHRV89.5FM for residents of Williamsburg. Credit: Eric Wickenheiser for graphics illustrative works

It should be noted that the near fringe area delineated by the outer circle is by no means the reception limit for these stations. In fact, at VCPP in Richmond using high quality receivers, we are routinely able to receive WHRV89.5 despite adjacent near WAUQ89.7 even though we are far outside of the protected contour.

The VCPP believes that the protected contour limits that were developed for analog FM should in no way be assumed to apply for the purposes of IBOC either for co-channel or adjacent channel interference because IBOC is an intentional interference and against the public interest.

The irony here is that analog provides greater range than the IBOC digital sidebands and thus the system is designed to “blend to analog”. But there are going to be places (such as the shaded areas above around and near Williamsburg) where the IBOC receiver has fallen off the digital cliff *but the analog to which it was to blend is destroyed by the other station’s IBOC sidebands*! What is even more amazing is that this “Black Hole” area is not for the fringe listeners but occurs within some of the protected contours and certainly within the inner fringe listenership of the kind that the NAB was allegedly opposing LPFM in order to protect!

This acceptance of the paralyzation of analog in the presence of first and occasionally second adjacent IBOC carriers is especially interesting because now the iBiquity VP reportedly said verbally in an interview 3/20/02 with Greg Edwards, Business Reporter for Richmond Times Dispatch (RTD) that they are no longer requesting mandatory analog sunset as then mentioned by reporter to Maxwell in follow-up interview for response.

This suggests that this interference will occur in perpetuity.

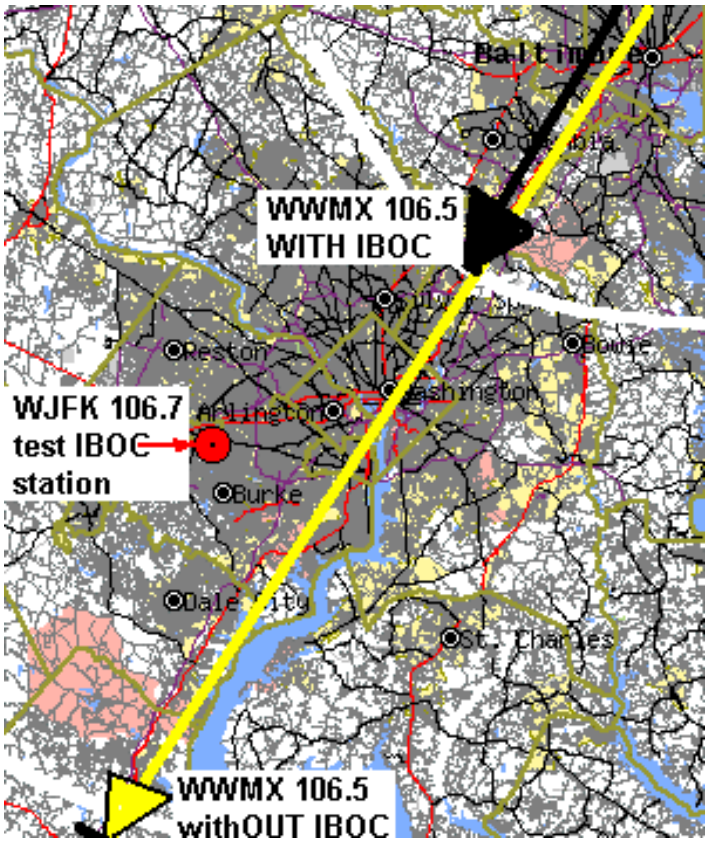
IBOC creates the worst of both worlds, neither IBOC nor analog receivers working in parts of the protected in inner fringe listening areas!

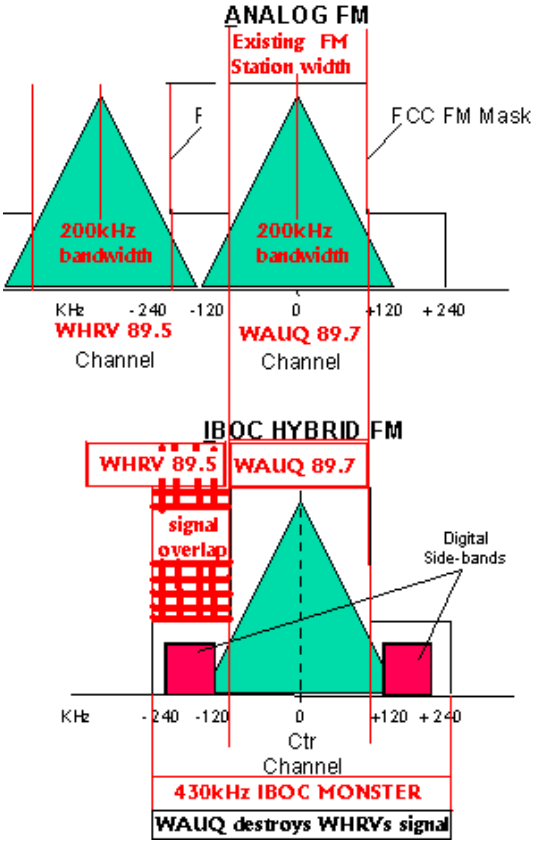
Consider also that the above map is confirmed by a real-world test, perhaps the *only* real world test of IBOC initiated by a third party that will not gain financially from iBiquity, the NAB or any of iBiquity’s ownership such as Clear Channel Inc.

On March 17th, 2000, Christopher Maxwell, Secretary of the Virginia Center for Public Press testified to the U.S. HOUSE OF REPRESENTATIVES SUBCOMMITTEE ON TELECOMMUNICATIONS, TRADE AND CONSUMER PROTECTION on HR3439 *THE FCC'S RADIO SPECTRUM MANAGEMENT* (page12) :

> “[an actual survey of the area around test IBOC station WJFK106.7 was performed. The sound and effect of IBOC was recorded] … several miles west of the intersection of Hwy 66 and I-495 where the digital IBOC carriers are extremely strong and destroy 106.5 WWMX completely so you are hearing stations on each side that would normally have empty buffer space in between them and WJFK's signal. Instead you hear their signal is now nearly contiguous to WJFK's spread-out signal.”

If you look to the end of these comments you can see the full Congressional Testimony. Not included in that testimony s this map showing the difference in coverage recorded:





One Real World Third-Party survey/test of the effects of a test IBOC station:

This map shows that when we drove an auto with a *Mustang* aftermarket car radio installed north on I-95, we did not receive WWMX106.5FM until just after entering Maryland after turning north on to I-95 where it continues north of the I-495 DC Beltway. This coverage range *with* the WJFK106.7 IBOC sidebands ON is displayed with the white line and black arrow. Then when the WJFK106.7FM sidebands were OFF, we went back with the same car, same radio installed and found that we were able to reliably receive WWMX106.5 throughout most of the District of Columbia as well as about 30 miles south of DC into Virginia (losing the signal in the troughs of the hills just south of Woodbridge Va.)

The graphic on the right is a modification of a graphic taken from a Lucent website describing IBOC digital sidebands. The same situation applies to WWMX106.5FM and WJFK 106.7FM. The amplitude energy of the sideband becomes a co-channel noise source that paralyzes the AGC and discriminator of the receiver thus causing nothing to be received over a huge portion of a previously available range but an aggressive hiss. This process is displayed by the difference between the black arrow and the yellow arrow on the map above.

We note that this is to our knowledge at this time, the ONLY third party NON iBiquity initiated and controlled test of IBOC's impact. This has disturbing AntiTrust possibilities to consider.

We note that Radio Kings Bay, Inc. on 3/20/02 essentially state that IBOC is a scheme to charge stations a royalty to continue to provide free over the air broadcasting service. First they may be required by the FCC to purchase equipment that levies a large licensing fee to use it. Kings Bay pointed out that this is in contrast with the establishment of FM technology that had no such equipment licensing fee. If conversion is mandated, Radio Kings Bay will be paying royalty to their competitors, Clear Channel Inc. and others who own iBiquity and furthermore are members of the NAB and the NRSC who have been left to determine whether IBOC is to be the mandated standard! If conversion is not mandatory, then Kings Bay will pay in the form of lost fringe listenership as noted in Visteon and iBiquity comments as well as potentially some of

their protected contour as well as demonstrated by our analysis of WAUQ and WHRV interaction in the maps in this comment.

Furthermore, if the transition is to be utterly voluntary then the IBOC services would be just as likely to be accepted or rejected by the *public* as Eureka 147 systems on the L-Band. Also, since the rest of the planet is already manufacturing Eureka 147 transmitters and receivers, it would be more cost-effective to use the Eureka system to make it more likely for the public and small broadcasters to be able to afford the equipment. This would alleviate all these electromagnetic and political gymnastics to try to get protection of close spaced stations owned by NAB and iBiquity partners but deny the same spacing to new LPFM ownership on the fiction that they are concerned about fringe listenership, then turn around and argue for IBOC saying that fringe listeners are a worthy tradeoff!

iBiquity Tests prove that IBOC hybrid has less range than analog, for that reason IBOC technology has "blend to analog" at the fringe reception area. (see iBiquity WETA tests above) BUT iBiquity's own statements show that the fringe listenership of an analog will be damaged by the adjacent IBOC station's digital sidebands ... thus destroying range for BOTH analog receivers AND for IBOC receivers. Please keep in mind that marketing surveys show people want VARIETY.

ALSO: What is to happen to short spaced IBOC stations when both their upper and lower digital sidebands have another IBOC sideband overlapping it? How does the IBOC receiver separate the two clusters of digital information if BOTH sidebands of desired station are clipped on both sides?

> NOTICE that there are no mappings of loss of listenership of analog adjacent by analog receivers or mappings of loss of listenership by IBOC receiver attempting to receive an IBOC that is sandwiched on both sides by two more powerful IBOC carriers.

NOTE that in 1992, Eureka was supported by NAB. The NAB only turned to the IBOC plan as a speculative technology when the US Military refused to volunteer the L-Band. *Communications Daily*,June 14, 1991, Friday , Pg. 7 reported:

> “NAB DAB Task Force Chmn. Alan Box said: "The FCC has expressed its faith in the future of DAB and is very positive about the use of L-band spectrum as a home for it." He said S-band is "unacceptable . . . We hope the FCC -- the expert agency -- will be able to convince NTIA and the State Department of the importance of L-band spectrum for terrestrial DAB. The door is still open."
>
> Comr. Duggan, who was optimistic U.S. could devise agreement on L-band, stressed that all 5 commissioners "are supporters of national security needs. I personally am a bloodthirsty hawk, and we're not going to do anything to prevent smart bombs from hitting their targets. We can find room for DAB."

Never mind that the rest of planet earth [except for a handful of holdouts like Britain using 220MHz] chose to use L-Band Eureka 147 and thus this statement suggests that smart bombs may only reach a proper target in places not using the L-Band such as Britain, Japan and the US.

On December 28, 2001, the FCC Commission announced that the following bands would be

We note however, that the L-Band has now been opened for use by wireless communications. The decision to open the L-band was announced by the Commission on December 28, 2001 in docket 00-221 to re-allocate 1427- 1429 MHz, 1429-1432 MHz, 1432-1435 MHz.

On Page 28, The FCC said on December 21 in docket 00-221,

> 44. The United Telecom Council and the American Public Power Association (UTC/APPA), in joint comments, support option 2. They argue that this option would allow utilities to increase productivity and efficiency and to establish a direct link to customer premises utility meters. (144) Additionally, UTC/APPA claim that Option 2 would promote competition in a deregulated environment. (145) Bay

> State Gas recommends that we adopt Option 2 because it would serve the public interest in providing a "home" for automatic meter reading and protect the substantial investment made by such equipment by utilities and other critical infrastructure companies. (146). These parties also assert that allocating the 1427-1432 MHz band for telemetry operations would harmonize spectrum use with Canada, thereby simplifying cross-border coordination and affording U.S. manufacturers and service providers a wider market opportunity. (147)

Note that the FCC seemed to value harmonizing our spectrum use with Canadian spectrum use.
We hereby incorporate by reference all of the filings that were made in docket 00-221 and related consolidated Dockets.

The arguments made in this docket 00-221 provide evidence for the proposition that absolute preservation of the L-band, for military purposes alone, is not necessary for national security.

Not only that, but the usage is flexible:
Page 17, December 21, 2001, The FCC said in docket 00-221:

> 36. The 1.4GHz spectrum encompasses 13 megahertz of spectrum in four segments at 1390-1395, 1427-1429, 1429-1432MHz, and 1432-1435MHz. **In the Notice, we did not make specific allocation proposals for these bands, but instead presented several options for consideration.**

Furthermore, an agreement between the US and Canada show that the US Military will, in 24 months from beginning of L-Band Canadian transmissions in certain longitudes, stop using the L-Band in a way that harms Canadian L-Band broadcasts. Thus we comment that this agreement and the Commissioners willingness to reallocate other portions of the L-Band indicate that while the military would not release the L-Band in 1992 thus pressuring the NAB to come up with IBOC, now that is no-longer the case and the L-Band is available as it was not in 1992 and provides support for the proposition that the retention of the L-Band, for purely military use alone, is no longer necessary for national security and that indeed, national security will be better served by military missile tests etc. moving entirely off the L-Band for higher more secure frequencies so that the missile telemetry will not have to compete with Elvis on Canadian L-Band for bandwidth. Besides, who wants to see what happens to a missile that is jammed by Elvis?

This agreement is undated, but can be seen at URL:
http://www.fcc.gov/ib/pnd/agree/tdrbagr.pdf
and says in part:

> "*Agreement on Coordination of Canadian Terrestrial Broadcasting at 1452-1492 MHz and U.S. Aeronautical Telemetry at 1435-1525 MHz*
>
> This agreement deals specifically with the Canadian Terrestrial Broadcasting at 1452-1492 MHz and U.S. Mobile Aeronautical Telemetry Service at 1435-1525 MHz. Canada is no longer pursuing a frequency allocation for Mobile Satellites in the 1435-1525 MHz band.
>
> 4. West of 83.25° West longitude, certain United States ATM transmitters and receivers in the states of Washington, Idaho and Montana will continue to operate in the 1452-1483 MHz band for a minimum of 24 months from entry into force of this agreement without affording protection to Canadian T-DRB operations. After 24 months, Canadian T-DRB operations would be protected from U.S. aeronautical telemetry when Canada advises the U.S. that T-DRB in a given area is ready to be brought into use. Both parties may agree to an earlier implementation of T-DRB transmitters on a case-by-case basis.
> 5. It is understood that this agreement can be reviewed at the request of either party.

You can see here that the US Military is being forced to back off their use of the L-Band due to Canada's decision to join the rest of planet earth in using 1452-1492MHz for Eureka-147 Digital Audio Broadcasting.

When that missile exceeds about 30,000 feet in altitude, midway down the US, it will suffer interference from Elvis on the Canadian L-Band ... as the missile climbs, you will find that problem exists all the way down to Mexico for that Missile test. Thus this band is no longer secure for military testing anyway.

IN CONCLUSION:

The alleged increase in sound quality appears to be within the margin of error of the Mean Opinion Score system used. Even if there *is* statistically significant increase in sound quality, it is a microscopically small portion of the full range of available ratings. Thus the alleged increase in sound quality is unproven. Besides, marketing experts such as M Street Daily have pointed out that what is driving the massive loss of listenership during the 1990s is not the “better sound quality” of internet radio and MP3 files… but the greater variety of content and less ads. National Public Radio also points out in their comments that in spite of the fact that FM is indeed a very very significant increase in sound quality over AM, FM did not take off as a popular medium until the FCC *forced* broadcasters to place unique content on the FM stations. The increase in sound quality alone, as marked and significant as it was for FM over AM was not compelling to listeners as was the increased diversity of content. Thus anything that has even the slightest potential to reduce the number of signals available to a listener of the broadcast bands is likely to increase the pressure to drive people off the broadcast bands and toward Internet, Music Choice, SDARS and CDs etc. IBOC will accelerate, rather than slow the loss of listenership on the AM and FM broadcast bands.

Also, some of the surveys show a non-random selection of surveyors for these sound quality tests with a population that is non-representative of the public actually listening to the radio today. So even the microscopic alleged increase in sound quality is questionable.

Secondly, the *one* truly independent test survey of the effects of an IBOC station on an adjacent by a third party not controlled or paid by iBiquity or iBiquity partners found essentially a jamming effect of a huge portion of the adjacent station’s signal coverage. iBiquity acknowledges that the digital signal in hybrid mode fails to cover the same or greater range than the analog host and accommodates this (as well as the very long digital acquisition time) with a “blend to analog” function. The irony is that this blend to analog will be paralyzed under many common conditions by the adjacent station’s IBOC sidebands! Thus the range will be dramatically reduced both for analog receivers AND for IBOC receivers.

And finally, the resistance of the military to release the L-Band in 1992 is no longer a problem. The military is already pressed into making agreements to cease much of their use of the L-Band because Canada is already joining the rest of Planet Earth in choosing to create DAB on the L-Band using existing production lines for Eureka-147 transmitters and receivers.

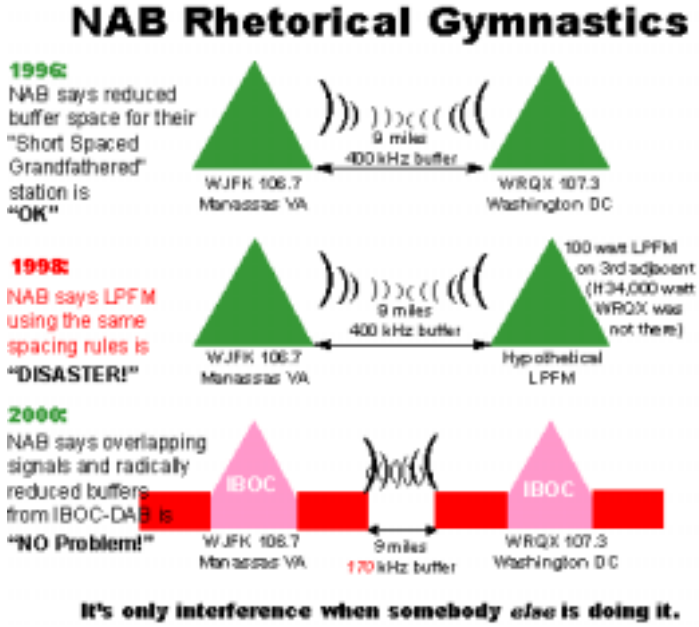
Thus it serves the interest of maximum transition speed and minimum cost to simply adopt the proven, functioning and cheaper world standard Eureka-147 standard on the L-Band of 1452-1492MHz.

APPENDIX:

NOTE: The Data and original mapping of the WAUQ and WHRV curves is due to the excellent work of Dave Bickel of the FCC and his development of FCC interactive web site.

That image was then enhanced for the purpose of illustration by Eric Wickenheiser, Graphics Designer.

Below is clipped the relevant portions of the HR3439 Congressional Testimony:



Looking at the graphic representation of the NAB's rhetorical gymnastics over the last four years, we see that not only do reduced buffers *not appear* to be the NAB's *real* motivation (since the buffers have *not* changed!) but the NAB themselves are pressuring the FCC to reduce buffers to nearly zero, and even pressuring to allow *overlapping* signals with a "*negative* "buffer in some cases.

In 1996, in FCC Docket # 96-120 (enclosed) , the NAB argued that due to advances in receiver technology, the current rules were "overly restrictive." While the NAB is not as glowingly supportive as broadcasters who serve more diverse audiences, such as WCPE, the NAB notably *did not suggest that their own existing short spaced stations be taken off the air either!*

Public broadcaster WCPE also stated in 96-120 (enclosed) support for the proposed relaxation of third adjacent restrictions to simply let the rest of us use the bent rules have allowed hundreds of stations such as WCPE to coexist peacefully on third adjacent frequencies.

Then in 1998, since the FCC agreed there was no problem in 1996 activists for greater *democratic* efficiency (more different voices on the public airwaves) argued we should *also* be able to use third adjacent frequencies, and even offered to come down from WAVA's 40,000 watts to under 3000 watts! LPFM was further bargained down to 100 watts.

Only two years later in 1998 and the NAB claims it will be a disaster.

And now two years again later (2000) than that and the NAB is arguing that buffers are beside the point with digital IBOC technology. (see below for more information).

2) "FM radio stations don't work like that!!" said Dr. Rappaport, nearly leaping from his chair at the hearings in response to the NAB engineer's testimony.

Dr. Rappaport is the James S. Tucker professor of electrical engineering at Virginia Tech, Blacksburg, and has been on the faculty for 12 years. In 1990, he founded Virginia Tech's Mobile and Portable Radio Research Group, one of the world's first research and education centers to specialize in the field of wireless communications. He also serves as Chairman of Wireless Valley Communications, Inc. in Blacksburg, VA.

Dr. Rappaport does not stand to gain or lose any money based on the outcome of these debates. He studied the NAB and the FCC studies and even agreed that there would be *very limited* interference.

Dr. Rappaport testified that :

> "My analysis concluded that LPFM will not cause unacceptable levels of interference to existing FM broadcast stations or their listeners. My computer simulations demonstrate that under the conservative proposal adopted by the FCC, in the absolute *worst* case, if all new LPFM stations used 100 Watts, then *at most*, 1.6 percent of listeners who could hear a new LPFM station might be unable to receive a currently existing broadcast station.
>
> "More importantly, the large majority of the affected listeners would actually be able to receive all current stations, and other affected listeners would be able to receive an incumbent station by simply moving their radios a few feet or by rotating them on their nightstands.
>
> "My analysis found that, by *using worst case interference assumptions* and by relaxing the second and third adjacent channel protections, 626 new LPFM stations could be added in 60 US cities. My recommendations would have allowed over 81 million new citizen-channels on the FM airways, with a worst case potential interference of 1.2 million citizen-channels (however, since the analysis was worst case, only a small fraction of the 1.2 million citizen-channels actually would have experienced interference of some kind).
>
> "However, the FCC adopted a more conservative approach, and insisted that all LPFM stations must obey the existing second adjacent channel projection rule, which reduces the number of new LPFM stations to 247 in the same 60 US markets. This reduces the number of citizens-channels by almost 300%, and decreases the number of potential interference events by the same factor."

SO Dr. Rappaport agreed *in limited part* with NAB testimony that there would be *some extremely limited* interference.

And *in spite* of that *very limited agreement*, Dr. Rappaport expressed very strong opposition to the representation of what interference sounds like as provided by the NAB engineer. Dr. Rappaport nearly stood up in the proceedings from his chair, interrupting the NAB engineer only after it became amply obvious that the hearings would not *politely* allow a competent technical challenge to the NAB testimony. Furthermore others who would NOT gain money from ending the LPFM competition were not allowed to properly address this issue, as Mr. Tauzin adjourned the meeting.

SO THE QUESTION STILL REMAINS. Does the NAB testimony accurately reflect the performance of real FM receivers actually picking up two FM signals simultaneously?

I invite the Congressmen to test whether FM interference is smooth or distorted for yourselves. Does the real world sound anything like the NAB "samples"?

Once again, as with WAVA105.1FM, if you drive west on I-66, and turn south on I-495, you can pick up two stations for this test. WPLC94.3FM is a very small station at only 2,000 watts in Warrenton VA. WARW94.7FM in Bethesda MD is 20,500 watts. This test radio only experienced interference for a few hundred feet along I-495 at the Highway 50 exit.

As you listen to the sample recorded interference, or repeat this test for yourself on your radio, ask yourself, does this sound like the samples that the NAB have in their testimony? Does this interaction sound like two smoothly mixed sound tracks? Or is there distortion?

As you listen to this sample of *actual* FM interference in the *real world*, notice a few things:
Is the interaction of the two signals a smooth clean mixing of the two audio tracks?
Our target sample station, the one that the radio is tuned to, the distant 94.3 is playing the Modern Contemporary Music (the foreground music, the guitar strumming).
The strong local station 94.7 is playing the *Classic Rock* song you hear only briefly.
Notice that the pop music is *replaced* in brief bursts by the *distorted* oldies rock soundtrack. The first recorded incursion appears at 37 seconds into this clip. This demonstrates the "capture effect" of FM demodulators. The FM receiver will lock onto one signal until the other signal absolutely overwhelms it and "jumps" to decoding the other signal, *not both signals at the same time*.
This jumping can also be rapid like the vibrato on a musical instrument creating a "shimmering" effect that shows *distortion*, not a smooth crosstalk.
This sample does *not* sound anything like the "evidence" sample that the NAB provided.
You can see from this example (which we urge you to go out and verify with your own radio) that there is significant *distortion*. Note that it is levels of *harmonic distortion* that the FCC used as their measure of alleged interference.
Notice the samples provided by the NAB were smooth like a studio mixture *as if both signals were of equal strength*, AND *as if both signals were coming from down the block*.
In this *real* example, our target station's signal, the pop music (strumming guitar) on 2000 watt 94.3FM 30+miles away *is so weak as to be nearly unlistenable even without the brief incursion* of signal bleed over from 94.7FM..

Note: Typo in original said "40+miles"

And so you can hear for yourself that the testimonial "samples" mixed together on the NAB engineer's laptop PC are misleading. As Dr. Rappaport said, "That's not how FM radio works!"

This recorded sample of *actual* interference experienced by a radio is available by clicking the speaker.

[NOTE:] This sample was taken from a $25 flea-market purchased third-party car radio tuned to 94.3FM in a moving car heading south on I-495 at the Hwy 50 exit.

[NOTE:] This radio's performance is way below that of most name-brand car radios, and about that of a regular boom box. So a normal car radio would not experience this interference and a boom box user would simply alter the angle of the antenna to tune out the incurring signal. Anything less than a boom box would not be sufficiently sensitive to hear 94.3FM *at all* thus making it a moot point for radios like a walkman. This station had been continuously monitored from the Centreville VA exit of I-66 and south of this location and the *brief* incursion of classic rock (starting at 37 seconds into the clip) you hear on the clip was the only significant interference recorded during the entire time monitoring the station, even after continuing south on I-495.
Note that 94.3 is so weak, it often cancels itself, or falls just below the threshold of the radio to detect and creates the intermittent hisses. These are *not* interference, that would happen regardless of any other stations in the area at the limits of the signal's reach.

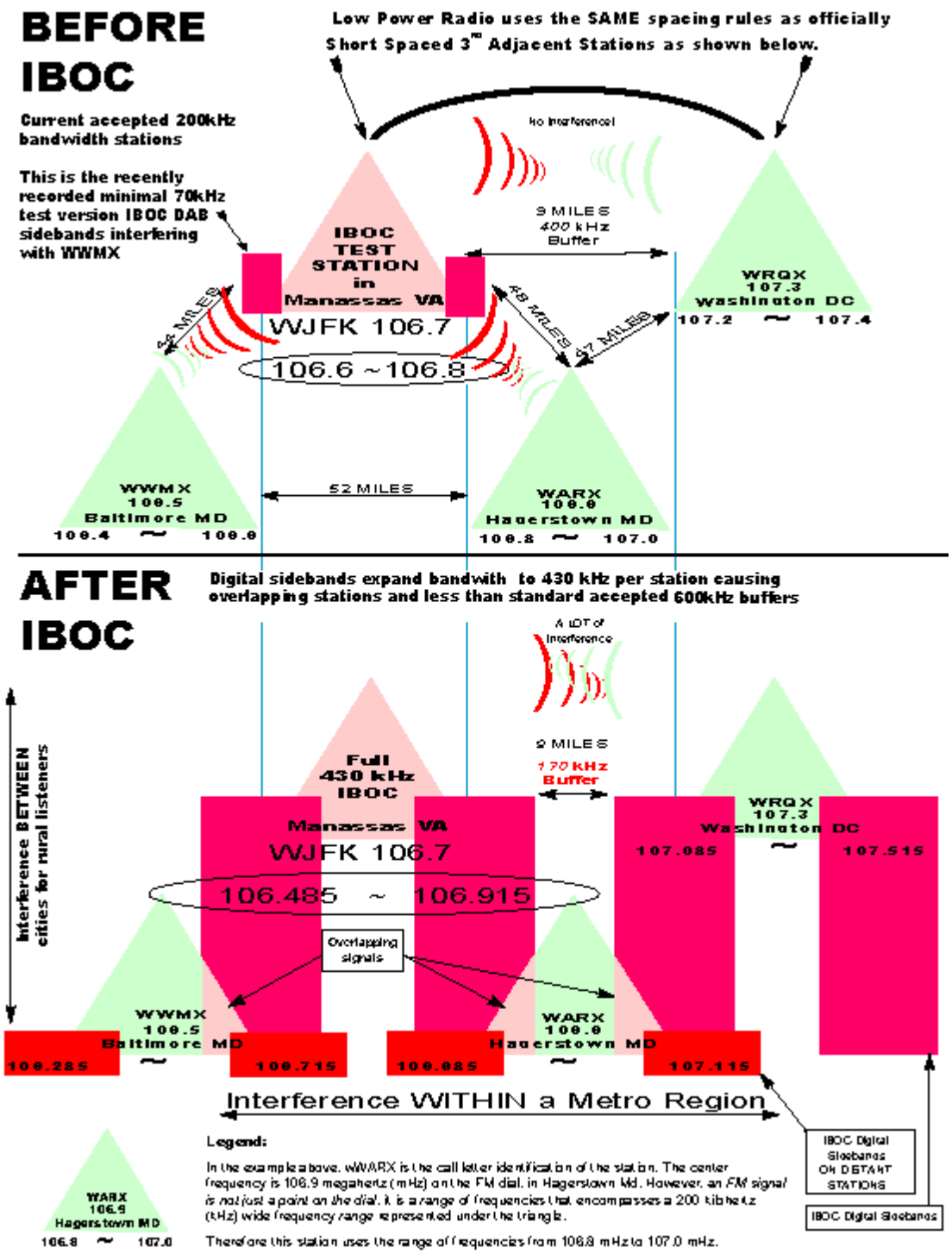
This also speaks to one of the questions asked by the Congressmen and never answered, "What *is* 'acceptable interference'?"
Nature is not a binary world, it is not day and suddenly completely night. Nature is not completely "on" or "off". Radio is no different.
If you then accept that there is no such thing as no interference, then it is *always* a matter *levels of acceptable* interference.
This recording shows that our favored signal, the weak contemporary music station at 94.3FM was so weak and full of noise as to be unlikely to have any significant audience at the point on Highway 495 where 94.7's signal briefly interfered!
And indeed, *nobody is on record complaining of interference between short-spaced stations to the FCC!!*
Therefore since Warrenton VA's 2000 watt 94.3's signal was *already too weak to maintain a consistent delivery* regardless of interference from Bethesda MD's 94.7FM, the geographically very limited interference you hear on this clip constitutes and example of "acceptable interference".
This clip also illustrates that the NAB testimony involving two sound tracks mixed in a sound PC was misleading, that indeed, "that's not how FM radio works" does best describe the best thing you can say about the NAB testimony.

3) Last but very much *not* least, if it can be shown that the NAB coalition is pressuring the FCC for changes in the rules that would create *massive* interference *by their own* stations *on others* ... might not the NAB's expressed interest in "spectrum integrity" be in serious doubt?

For more information on IBOC please visit this link and view some of the other Virginia Center for the Public Press comments and reply-comments regarding IBOC-DAB before the FCC and Congress (FCC Docket 99-325)

As you will see (and hear) in the graph and sound recorded from actual signals from WJFK106.7FM in Northern Virginia, this is exactly what is happening.

WJFK106.7FM in Northern Va. is a test station for a new kind of broadcasting called IBOC-DAB (In-Band, On-Channel Digital Audio Broadcasting).
This new kind of broadcasting sends out sound the same way a fax machine sends out a picture, by converting the sound into little blocks that are on or off. IBOC means that they plan to "hang" the digital signals like saddlebags on the two outer sides of an existing station.
I urge you to test this for yourself, drive West on I-66 again. While in downtown DC, tune your radio into 106.5FM from Baltimore.
At first you will just hear WJFK occasionally stomping the Baltimore signal. Then as you go west, you will hear a distinct "buzz saw" sound. Now *from*106.5 tune the radio up past 106.7 to and through 106.9FM. You will notice *very distinctively* that it sounds as if two fax machines were transmitting on two new stations on either side of WJFK.
Actually, that is almost exactly what *is* happening. There are two digital transmitters (the red blocks in the IBOC graphs) that are transmitting on the immediate adjacent frequencies of WJFK. The analog portion of the signal is represented by the green triangle.
[NOTE:] Analog LPFM station would never cause this interference because it would be required to operate no closer than the third adjacent FM frequency or "channel" on the FM dial.
You can hear for yourself what this *already* means for listeners of WWMX106.5FM out of Baltimore. **NOTE: During the visit to deliver this into the record by hand-delivery … author discovered that WJFK has ceased broadcasting the Digital IBOC side carriers. However, you can still try the *same* test using WETA90.9FM's test IBOC signals as they "buzz" WJYJ90.5FM for listeners in downtown Washington DC and 20 or so miles south as well.**


BEFORE IBOC
Low Power Radio uses the SAME spacing rules as officially Short Spaced 3rd Adjacent Stations as shown below.
Current accepted 200kHz bandwidth stations
This is the recently recorded minimal 70kHz test version IBOC DAB sidebands interfering with WWMX
No Interference!
9 MILES
400 kHz Buffer
IBOC TEST STATION in Manassas VA
WJFK 106.7
106.6 ~ 106.8
WRQX 107.3 Washington DC
107.2 ~ 107.4
WWMX 100.5 Baltimore MD
100.4 ~ 100.0
52 MILES
WARX 100.0 Hagerstown MD
100.8 ~ 107.0
AFTER IBOC
Digital sidebands expand bandwidth to 430 kHz per station causing overlapping stations and less than standard accepted 600kHz buffers
A LOT of Interference
Interference BETWEEN cities for rural listeners
2 MILES
170 kHz Buffer
Full 430 kHz IBOC
Manassas VA
WJFK 106.7
106.485 ~ 106.915
WRQX 107.3 Washington DC
107.085 ~ 107.515
Overlapping signals
WWMX 100.5 Baltimore MD
100.285 ~ 100.715
WARX 100.0 Hagerstown MD
100.085 ~ 107.115
Interference WITHIN a Metro Region
Legend:
In the example above, WWARX is the call letter identification of the station. The center frequency is 106.9 megahertz (mHz) on the FM dial, in Hagerstown Md. However, an FM signal is not just a point on the dial. It is a range of frequencies that encompasses a 200 kilohertz (kHz) wide frequency range represented under the triangle.
Therefore this station uses the range of frequencies from 106.8 mHz to 107.0 mHz.
WARX 106.9 Hagerstown MD
106.8 ~ 107.0
IBOC Digital Sidebands ON DISTANT STATIONS
IBOC Digital Sidebands

Even *more* amazing, what you are hearing is only the *tip* of the impending NAB-sponsored interference iceberg of IBOC-DAB! The NAB coalition is pressuring the FCC to allow that buzz saw to EXPAND, to *double* in size to 430kHz in bandwidth. But the sample you hear and the buzz you will hear if you yourself repeat the test mentioned above is only the 70kHz version that theoretically stays within the currently allowed 200kHz bandwidth! Please realize the vitally important point here that WJFK is testing the absolute most *minimal* version of the IBOC sideband digital carriers comprising only 70kHz of bandwidth and *supposedly* positioned to exist *within* the space on the FM dial normally legally allowed WJFK. Wait until the full 430kHz bandwidth version is rolled out!! Those stations above and below WJFK are going to have a rough time reaching anyone.

Not only will you *never* hear WWMX106.5FM from Baltimore again you may not even hear several DC stations either! What is to happen to the listeners of WRQX and WJFK in downtown Washington? WRQX-DC and WJFK-VA are only 9 miles apart geographically. And if a buffer space of only 400kHz is going to be a disaster for 100 watt LPFM stations and listeners, imagine what a disaster the 22,500 watt WJFK and 34,000 watt WRQX stations will be *with only 170kHz of buffer in-between.*

For this reason, the Virginia Center for the Public Press has submitted [enclosed] a request for extension of Reply-Comment period in the FCC Docket 99-325 (impact of IBOC-DAB) proceedings. We requested a full publicized test of the full 430kHz IBOC test signal on *both* WJFK106.7 and WRQX 107.3FM with proactive involvement of the population of listeners.

In other words, the LPFM *as well as the other already existing 300+ "Short Spaced" third adjacent stations* (like WAVA105.1FM and like WRQX-WJFK) must maintain a "buffer" of two channels in between themselves and other stations on the local FM dial. Thus an LPFM would only be allowed at 106.1FM or 107.3 and then only if there are *another* two unoccupied buffer spaces on the other outer sides of those two slots *as well.*

This means that Washington DC listeners of WWMX106.5FM from Baltimore would still hear their station with LPFMs, but *not* with the *NAB's proposed* IBOC-DAB in place.

You can *hear* the square waves of IBOC on-off-on" carriers as represented by the red blocks as you tune up through WJFK and through to the other side.

By Clicking The Speaker Here, you can also hear a recorded clip of a radio tuning through the three stations:

- Starting at 107.3FM playing contemporary music
- and through the *upper* IBOC "saddlebag"
- then 106.7's *analog* signal (the talk program)
- then though the *lower* IBOC digital "buzz saw" sounding "saddlebag"
- to 105.9FM
- and back up thru WJFK returning to the contemporary music on 107.3FM.

[NOTE: What to listen for.] This was recorded several miles west of the intersection of Hwy 66 and I-495 where the digital IBOC carriers are extremely strong and destroy 106.5 WWMX completely so you are hearing stations on each side that would normally have empty buffer space in between them and WJFK's signal. Instead you hear their signal is now nearly contiguous to WJFK's spread-out signal.

In Conclusion:

The rhetorical gymnastics the NAB are performing for you should win the Olympics. They claim that LPFM is a threat to "spectrum integrity", that is my ability to hear what I want.
Thirty percent of the CDs sold are of musical genres rarely heard on most radio stations such as Techno, Jazz, Classical, Folk. There are more moderate and liberal listeners of news-talk, yet most talk *hosts* are conservative. Thirty percent of American's interests are provided by the small independent commercial, noncommercial college, religious and community radio stations that account for 20% of the listenership. Thus 20% of America stands to lose access to the smaller stations that would be utterly destroyed by the brain-child of the *NAB* (IBOC-DAB) ... *reducing* the variety of choices for consumers ... while *LPFM* would *open vistas* of *new* programming opportunities. The tradeoff under the *worst* case scenarios show a loss of about 1% of access in exchange for nearly DOUBLING the number of choices.
The NAB is willing to create misleading testimony and "samples" of hypothetical third adjacent stations when there are plenty of real-world third adjacent stations right there in your neighborhood. Furthermore there are a plethora of options that the NAB could have suggested, they could have suggested a law requiring the incumbent broadcasters to open their Subcarriers to nonprofits as are done for many cable companies with "Cable Public Access." The NAB could have offered a compromise to do the same with the SAP channel on MTS encoded TV sound signals and also for the new multiplexed signals available under digital.
But did they make these suggestions and offers? No. Instead they cook up a harebrained scheme to sell us something we don't want (IBOC-DAB) by *forcing* it upon us in the form of "mandatory sunsetting of analog" broadcasting.
DAB has been a market FLOP in Europe where they have a *choice*, and yet ironically in America, supposed land of the free, we may lose that market choice and about half of the smaller niche market stations available now!

Even while NAB stations transmit on third adjacent frequencies thus creating room for *themselves*, they would *deny us equal treatment under the law and regulation.*
Their *only* answer is "There's No Room At The Inn."