Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554–0001

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

To: The Commission and Media Bureau

SUPPLEMENTARY COMMENTS

I. INTRODUCTION

1. My name is Jonathan E. Hardis, and I very grateful to the Commission for this opportunity[1] to file supplementary comments regarding iBiquity's late-filed study, "HD Radio™ Asymmetric Sideband Laboratory Test Report."[2]

II. IBIQUITY CONTINUES TO MISSTATE § 73.317

2. This new study contains many graphs that are much more colorful than the ones I referenced in my recent comments,[3] but no more factual. I call the Commission's attention to the following Figures: 1-1 (at p. 5) 1-2 (at p. 5), 1-3 (at p. 6), 1-4 (at p. 6), 5-2 (at p. 17), 6-1 (at p. 19), 6-3 (at p. 20), 6-5 (at p. 21), 6-7 (at p. 22), 6-9 (at p. 23), 6-11 (at p. 24), 6-15 (at p. 26), 6-17 (at p. 27), 6-19 (at p. 28), 6-21 (at p. 29), 6-23 (at p. 30), and 6-25 (at p. 31). Each of these figures contains a heavy green line that purports to be "FCC R&R 73.317." However, like the plots before them, these are false representations of what § 73.317 actually allows.

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[1] *See* http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-11-2056A1.pdf.
[2] Comments of iBiquity Digital Corporation, December 19, 2011, MM Docket No. 99–325, at http://fjallfoss.fcc.gov/ecfs/document/view?id=7021751178
[3] Comments of Jonathan E. Hardis, December 19, 2011, MM Docket No. 99–325, at 11 and 13; electronically at http://fjallfoss.fcc.gov/ecfs/document/view?id=7021751134

3. It makes little difference if a plot is labeled dBc "per kilohertz," or dBc "in 1 kHz," or dBc "1 kHz RBW," or dBc "in 1 kHz bandwidth." All of these mean essentially the same thing: that the plot is of power spectral density in units of measurement dBc/kHz. For these plots there is direct confirmation of this. They all contain a curve labeled as "NRSC 5C," which comports with values with units of measurement dBc/kHz in the original source.[4] The original source repeatedly uses the term "power spectral density" in its specifications.

4. Here, the use of the label "1 kHz RBW" is silly. "RBW" is an indirect reference to a "spectrum analyzer," a type of measuring instrument that is commonly used to analyze signals in the frequency domain. The acronym "RBW" stands for "resolution bandwidth," which is one of the operating controls of the instrument. In data presentation, it is a disclaimer that the spectrum analyzer was employing a low-pass filter that would preclude the plot from showing measurement resolution at a finer scale than the RBW value, here 1 kHz. However, these are hand-drawn figures, not spectrum analyzer measurements. (None of these figures are test results. They are all artistic conceptions of various test setups.) The artist who drew these figures made an artistic rendering of the individual subcarriers (labeled as "carriers"), which have spectral separation of 0.363 kHz. Since an RBW of 1 kHz is much coarser than a fine structure resolution of 0.363 kHz, an actual spectrum analyzer with an RBW of 1 kHz would filter out the subcarrier structure, and you would not see it.

5. To repeat the key point here: the spectral mask "NRSC 5C" is a differential specification, in dBc/kHz (or, if you prefer, "dBc in 1 kHz"), given as a continuous function of frequency. The spectral mask in § 73.317 is an integral specification, dBc as integrated between bounds in frequency (e.g., "dBc in 240 kHz," between the bounds of –240 kHz and –120 kHz,

[4] iBiquity Digital Corporation, "HD Radio™ FM Transmission System Specifications," Rev. F, August 24, 2011, SY_SSS_1026s, at 4.4.1 (p. 6); electronically at http://www.nrscstandards.org/download.asp?file=NRSC-5-C.asp

and the bounds of 120 kHz and 240 kHz, for § 73.317(b)). They are not directly comparable, and they cannot be plotted on the same graph. By "differential" specification, I mean that specifications of power spectral density are powers measured with a spectrum analyzer in an arbitrarily small bandpass, which are then scaled and stated in usual units, here, dBc/kHz. A bandpass of 1 kHz is acceptably small in this application, and makes the scaling to dBc/kHz trivial.

6. There is a simple argument that cuts through the clutter and semantics. If it is true that broadcasters are already entitled to broadcast up to the limits of § 73.317, and if it is true that § 73.317 provides interference protection, then why is the thick red line below the thick green line in these figures? Why aren't iBiquity and the broadcast community already taking advantage of the headroom allowed and already pushing up against the thick green line? The answer is that the thick green line is not § 73.317, and if they were to actually broadcast with sideband powers of –25 dBc/kHz, it would be blazingly obvious that these are not the *de minimis* emissions that § 73.317 permits—that is, if the transmitters didn't melt first.

7. In 1998, iBiquity petitioned the Commission that § 73.317 should be waived for hybrid digital transmission. Today they assert that –10 dBc complies with its –25 dBc mask limit. I hope understanding is reached on this issue quickly, because these recent claims are like an assertion (with apologies to Groucho Marx) that Mr. Lincoln is buried in Grant's Tomb.

III. ADDITIONAL COMMENTS ON THE TEST REPORT

8. My further comments on this Test Report are of less importance than those of the last section, but perhaps worth mentioning anyway. First, I am somewhat surprised by the choice of radios tested and reported. These tests were conducted on three automotive radio using integrated circuit components ("chipsets") designed for that market. However, elevated sideband powers were advocated primarily to accommodate portable and indoor receivers, such as the

Microsoft Zune.[5] These devices use special low-power chipsets manufactured by Samsung[6] and Intel (formerly SiPort).[7] The omission in the report on testing of such devices is puzzling.

9. Perhaps a greater surprise is the result of the test combinations shown in Figures 6-16, 6-18, and 6-20. To set the stage, I refer your attention first to Figures 6-2, 6-4, and 6-6. These were tests of symmetric sideband powers in the presence of additive white Gaussian noise (AWGN). The independent variable in these three tests was the ratio of digital carrier power to the background noise (Cd/N0). So, even though the digital carrier power increased through the progression of these three tests, from –20 dBc (–23 dBc each sideband), to –14 dBc (–17 dBc each sideband), to –10 dBc (–17 dBc each sideband), the background noise increased as well. Indeed, radio receivers typically have circuitry to provide "automatic gain control" to compensate for the range of broadcast powers that might be received. So it should come as no surprise that the radio receivers apparently compensated for the varying digital carrier powers and were only sensitive to the ratio of signal to noise. In all three cases, the bit error rate of 5×10^{-5} was obtained at roughly a signal-to-noise ratio (Cd/N0) of 54.5 for the P1 carriers and 55.75 for the P3 carriers. Now, compare these results to the same tests conducted in the presence of an additional interferer, a first-adjacent channel signal with a D/U ratio of 6 dB. Figures 6-16, 6-18, and 6-20 show that signal-to-noise ratio required to obtain a bit error rate of 5×10^{-5} is no longer the same. However, the progression seems odd. At the lower digital carrier power (–23 dBc each

[5] "The upcoming introduction of portable HD Radio products this fall has greatly increased the urgency for Commission action on this issue. Microsoft Corporation recently announced the next generation Zune music player will include HD Radio technology." Comments of iBiquity Digital Corporation, July 6, 2009, MM Docket No. 99–325; electronically at http://fjallfoss.fcc.gov/ecfs/document/view?id=7019808294.
The Microsoft Zune was discontinued as a product in 2011.

[6] *See* http://www2.prnewswire.com/cgi-bin/stories.pl?ACCT=109&STORY=/www/story/05-27-2008/0004820768&EDATE=

[7] *See* http://www.intel.com/content/www/us/en/wireless-products/digital-radio-analog-fm-receiver.html.

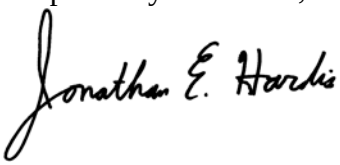
sideband) it requires a signal-to-noise ratio of about 56.5 (for the P1 carriers), at the medium power (–17 dBc each sideband) it requires a signal-to-noise ratio of about 57.4, and at the highest power (–13 dBc each sideband) it requires about 57.1. One would expect the lowest required signal-to-noise ratio for the highest power sidebands, not the lowest. When the sidebands have the greatest power relative to the carrier, the additional adjacent channel interferer, which has a fixed power relative to the carrier, is relatively smaller in scale.

10. Nonetheless, the operative question requiring laboratory confirmation is whether or not the installed base of receivers can handle asymmetric sidebands, and in particular, the 4 dB difference in the –17 dBc/–13 dBc case. The data indicate that they can. The key Figures are 6–13 and 6–15. For the P1 carriers, Figure 6–16 shows that –17 dBc/–13 dBc scales just like the aforementioned –23 dBc/–23 dBc case (not plotted), the –17 dBc/–17 dBc case (plotted) and the –13 dBc/–13 dBc case (not plotted). For the P3 carriers, for reasons that aren't entirely clear, only 3 dBc of the 4 dBc power increase provide benefit, 1 dBc does not. The tests further show that an adjacent channel signal adds to the asymmetry by creating a higher noise floor under the weaker sideband. However, this effect would only occur in the portion of the station's coverage area closest to the adjacent-channel signal source.

IV. CONCLUSION

11. While the Test Report indicates the technical viability of asymmetric sideband operation, particularly where the asymmetry is 4 dBc or less, it nonetheless continues to perpetuate the myth that elevated sideband powers (asymmetric or not) lie within (comply with) the Commission's FM emissions mask as given in § 73.317 of the Commission's rules. In reality they do not, and for this and other reasons as explained in my earlier comments, the request should not be granted.

Respectfully submitted,



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Dated: January 3, 2012