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

In the Matter of	)	
	)	
Amendment of Section 74.1231(i) of the Commission's Rules on FM Broadcast Booster Stations	)	MB Docket No. 20-401
	)	
Modernization of Media Regulation Initiative	)	MB Docket No. 17-105
	)	
Amendment of Section 74.1231(i) of the Commission's Rules on FM Broadcast Booster Stations	)	RM-11854

COMMENTS OF
THE NATIONAL ASSOCIATION OF BROADCASTERS

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I. INTRODUCTION AND SUMMARY

In December 2020, the Commission issued a Notice of Proposed Rulemaking (NPRM) regarding a proposed rule change that would authorize the origination of distinct, geo-targeted signals using FM booster stations.[1] The Media Bureau now seeks comment on developments in this matter since the comment cycle closed in March 2021.[2] The proponent of the rule change, GeoBroadcast Solutions LLC (GBS), has conducted two recent self-designed field tests of its exclusive technology ZoneCasting™, in San Jose, California with FM Station

[1] *Amendment of Section 74.1231(i) of the Commission's Rules on FM Broadcast Booster Stations*, Notice of Proposed Rulemaking, 35 FCC Rcd 14213 (2020) (NPRM).

[2] *Media Bureau Seeks Comment on Recent Filings Concerning Use of FM Boosters for Geo-Targeted Content*, Public Notice, DA 22-249 (rel. Apr. 18, 2022).

KSJO(FM),[3] and in Jackson, Mississippi with Station WRBJ-FM.[4] Unfortunately, both tests are either invalid and/or useless, and simply do not support GBS's claim that ZoneCasting can be deployed "without negatively impacting the listener experience."[5] To the contrary, these tests – and the fact that more robust, objective tests were not pursued – make clear that ZoneCasting will cause unacceptable interference that harms consumers and undermines the public interest.

It is critical at the outset to understand that there are two general approaches to testing a proposed technology. The first approach is testing a system under a series of real-world challenging scenarios either to discover potential flaws in a system so they can be addressed or to demonstrate a system's efficacy. These kinds of tests are valuable because they seek to approximate real-world conditions and discover a system's true capabilities.[6] The second approach is designed to put a system's best foot forward, to cover up the blemishes, and only show the reviewers what the system's proponent wants them to see. While the FCC and the radio industry critically needed to see and review the first kind of test, GBS's efforts are squarely developed to serve the latter, more cosmetic, purpose. If GBS was genuinely interested in proving its concept, it would have conducted tests that approximate uses in the

[3] Letter from Gerard J. Waldron, Covington & Burling LLP, to Marlene H. Dortch, Secretary, FCC, MB Docket Nos. 20-401 and 17-105, and RM-11854 (Sept. 17, 2021), attaching Roberson and Associates, LLC, "KSJO(FM) Demonstration System, Geo-Targeted FM/HD Broadcast Technical Report" (KSJO(FM) Cover Letter or KSJO(FM) Test Report).

[4] Letter from Gerard J. Waldron, Covington & Burling LLP, to Marlene H. Dortch, Secretary, FCC, MB Docket Nos. 20-401 and 17-105, and RM-11854 (Mar. 30, 2022), attaching Roberson and Associates, LLC, "WRBJ-FM Demonstration System, Geo-Targeted FM/HD Broadcast Technical Report" (WRBJ-FM Cover Letter or WRBJ-FM Test Report).

[5] WRBJ-FM Cover Letter at 5.

[6] A good example of this approach is the extensive testing of HD Radio and involvement of the National Radio System Committee (NRSC) and the entire radio industry. Public Notice, *Comment Sought on National Radio Systems Committee DAB Subcommittee's Evaluation of the iBiquity Digital Corporation IBOC System*, MM Docket No. 99-325 (Dec. 19, 2001).

real world and allowed interested parties to get a complete look under the hood. Instead, GBS has studied ZoneCasting's impact in a few handpicked scenarios, ignored the vast majority of more likely situations, insufficiently addressed ZoneCasting's impact on digital radio, and failed to comprehensively measure ZoneCasting's effects on actual listeners. Regardless, as we discuss in further detail below, even with GBS's cherry-picked scenarios, its results still demonstrate that the public will be harmed if GBS's proprietary systems are permitted to be employed.

To be sure, the National Association of Broadcasters (NAB)[7] has approached this proceeding with an open mind. We supported public consideration of GBS's Petition for Rulemaking proposing ZoneCasting,[8] and commended the FCC for exploring new ways to help local radio remain a robust service for the American public.[9] However, the radio industry's subsequent examination of GBS's proposal revealed certain fatal flaws in GBS's policy rationale. Now, in addition to GBS's flawed policy justifications, the radio broadcasting industry has concluded that GBS's technical claims are defective as well, and permitting ZoneCasting's operation will almost certainly drive listeners away from terrestrial radio and put listeners' safety at risk.

NAB's conclusions on this score are drawn in part from the work of John Kean, Senior Engineer at Cavell, Mertz & Associates, Inc.[10] Mr. Kean is an industry expert at conducting

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[7] NAB is a nonprofit trade association that advocates on behalf of local radio and television stations and also broadcast networks before Congress, the Federal Communications Commission and other federal agencies, and the courts.

[8] Comments of NAB at 5-6, RM-11854 (May 4, 2020).

[9] Comments of NAB at 1-2, MB Docket Nos. 20-401 and 17-105, and RM-11854 (Feb. 10, 2021) (NAB Comments).

[10] John Kean, *Analysis of Technical Reports for ZoneCasting at KSJO(FM), San Jose, CA and WRBJ-FM, Brandon, MS* (ZoneCasting Tests Analysis), attached hereto. NAB's in-house

and evaluating audio listening studies and radio frequency interference studies. Indeed, Mr. Kean previously studied ZoneCasting (and GBS's other product, MaxxCasting) at GBS's request while Mr. Kean served as a Senior Technologist at NPR Labs.[11] Mr. Kean, along with Dr. Ellyn Sheffield, a professor and subjective evaluation expert from Towson University, designed and built a scientific listener-based test system to measure the effects of GBS's technology on the quality of radio audio between the primary and booster stations and develop and recommend acceptable listening parameters. GBS itself has referenced Mr. Kean's expertise regarding its technology long after Mr. Kean's engagement with GBS concluded.[12] Given this experience, Mr. Kean is one of the most, if not the most, qualified engineers to provide an objective, accurate review of GBS's ZoneCasting tests at KSJO(FM) and WRBJ-FM.[13]

As the ZoneCasting Tests Analysis explains, the artificially favorable design of GBS's field tests raises far more questions than the tests purport to answer. Neither test addresses numerous critical issues raised by the Commission in the NPRM or by industry,[14] and both

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technologists, who are prominent broadcast engineers in their own right, separately evaluated the GBS test reports and concur with Mr. Kean's findings.

[11] John Kean, NPR Labs, and Ellyn Sheffield, Melinda Hines, Towson University, *Design Parameters for Analog FM Signal Repeaters Based on Listener Testing*, attached as Exhibit C to Reply Comments of GBS, RM-11854 (May 19, 2020) (NPR Labs Study).

[12] *See, e.g.*, Petition for Rulemaking, GeoBroadcast Solutions LLC, RM-11854, at 5 and 8 (filed Mar. 13, 2020) (GBS Petition); Letter from Gerard J. Waldron, Covington & Burling LLP, to Marlene H. Dortch, Secretary, FCC, MB Docket Nos. 20-401 and 17-105, and RM-11854 (Oct. 9, 2020) attachment at 8.

[13] NAB and NPR jointly commissioned Mr. Kean's evaluation of GBS's tests at KSJO(FM) and WRBJ-FM. Although NPR and NAB agree that Mr. Kean's evaluation shows that authorizing ZoneCasting will harm both listeners and radio stations, we have chosen to file separate comments given the differing missions and perspectives of our respective organizations.

[14] NPRM, 35 FCC Rcd at 14217 (asking a myriad of FCC questions that remain unanswered, including: "What would the listener experience as they moved between zones broadcasting different content or if they otherwise were located near the boundary between two zones (e.g.,

test reports rely on questionable methodologies that skewed the results, thereby negating their usefulness. For example, both tests used "back-to-back" boosters located adjacent to the roadways, and measured ZoneCasting's performance on only a miniscule portion of the roadways in each market, and only on the nearest, most ideal routes for traversing the area where interference occurs. Both tests failed to closely examine ZoneCasting's impacts outside those limited areas, including large areas where harmful and disruptive interference is predicted between the ZoneCasting network and the station's primary signal. These exceedingly favorable scenarios are not a reasonable simulation of ZoneCasting deployments that would be expected under normal or common conditions, and NAB and Mr. Kean are flummoxed that GBS's engineering consultants would hold them out as such. GBS has effectively attempted to "catfish" the Commission by submitting only glowing test results for extremely circumscribed, specifically engineered situations as representative of ZoneCasting's impact on listeners generally throughout a market. Accordingly, the Commission should save itself more time, effort, and energy by swiping left on GBS's rigged tests.

Even under the favorable conditions examined by GBS's consultants, the tests confirm that ZoneCasting will cause unavoidable, unresolvable interference that will harm listeners in large geographic areas.[15] At best, based on GBS's own data, listeners in cars driving 60 mph

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someone whose home was near the boundary (fixed) or who was driving along or close to the boundary (mobile)? Could there be circumstances in which a listener travelling in an automobile moves from a booster zone to the primary zone and then to another booster zone in quick succession? How would these sudden, repeated changes impact the listening experience?"); NAB Comments at 24-29 (listing numerous remaining questions concerning synchronization and booster placement, and ZoneCasting's impact on HD Radio and emergency alerting).

[15] We note with amusement that GBS has described WRBJ-FM's terrain as a "worst-case scenario for constructing zones," without mentioning that the test only studied ZoneCasting's impact in a miniscule portion of WRBJ-FM's service area. Letter from Gerard J. Waldron, Covington & Burling LLP, to Marlene H. Dortch, Secretary, FCC, MB Docket Nos. 20-401 and 17-105, and RM-11854, at 2 (Apr. 18, 2022).

on GBS's most ideal route for traversing the artificially minimized interference area caused by ZoneCasting may experience interference for up to seven seconds.[16] A disruption of this length will certainly confuse listeners and potentially cause them to change channels or switch to satellite or online radio.[17] In other, more likely circumstances, listeners driving 30 mph could lose clear radio reception for up to *13 second*s, and even longer depending on traffic conditions and the specific route taken through the interference area. For example, listeners traversing the interference area diagonally or driving tangentially along the boundary of the interference area could be subject to much longer disruption.[18] At worst, ZoneCasting could endanger listeners stuck in traffic as they try to escape severe weather or another emergency. Moreover, even under these scenarios, the interference will be widespread because the geographic areas in which the ZoneCasting network and the primary signal overlap may be extremely large (and far larger than the miniscule area GBS actually studied).

It is important to note that, unlike the convenient siting used for GBS's tests, the topography of many radio stations' service areas will not allow them to place boosters at locations that artificially limit the interference caused by geo-targeting. Many stations do not have high-speed highways in their area or may cover areas with large stationary populations in or near the areas of interference caused by ZoneCasting.[19]

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[16] WRBJ-FM Test Report at 29, Table 5.

[17] The ZoneCasting Tests Analysis contains never before publicly released information that highlights the objectionable nature of the ZoneCasting transition areas. ZoneCasting Tests Analysis at 3.

[18] This point must be left to conjecture because GBS did no testing of these important and frequently occurring sets of conditions.

[19] Any such disruption is especially concerning because the majority of radio listening takes place in cars. NAB and others have previously explained the significance of degrading radio quality in cars. NAB Comments at 20; Comments of Xperi Holding Corporation (Xperi) at 5, MB Docket Nos. 20-401 and 17-105, RM-11854 (Feb. 10, 2021). Car manufacturers are

Also, based on Mr. Kean's considerable expertise, NAB understands that consumers will not stomach interference for very long before seeking a new station or service. Most listeners are extremely quick to perceive poor radio service and register their annoyance by changing channels or audio sources in a matter of only ten seconds or so. Thus, any disruption caused by ZoneCasting will confuse or aggravate listeners because the length of such disruption will frequently exceed listeners' tolerance levels. And even if ZoneCasting is implemented on a voluntary basis, the resulting damage will affect *all* radio stations, including stations that do not use the system, as more listeners switch to Sirius XM or Spotify and complain to their car manufacturers about terrestrial radio's resulting shoddy service.

After a careful review that included thorough computer simulations of both the KSJO(FM) and WRBJ-FM tests using industry-standard state-of-the-art VHF signal propagation software, Mr. Kean concludes that ZoneCasting will cause unacceptable signal interference that will harm listeners, and will do so regardless of how carefully the geo-targeting system is installed, operated and maintained. Moreover, as Xperi has pointed out, properly operating and maintaining a sophisticated booster system like ZoneCasting is not a simple matter;[20] thus, if ZoneCasting is actually employed, the Commission can expect even more problems than Mr. Kean predicts.

In reaching this conclusion, Mr. Kean identifies a series of omissions, lop-sided analysis, and skewed reporting regarding both tests, including the following regarding the KSJO(FM) test:

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extremely sensitive to consumer complaints about their entertainment systems. Such complaints can reduce a vehicle's ratings, and encourage carmakers to exclude broadcast radio.

[20] Xperi Comments at 6-12 (describing ways that broadcasting different content on a co-channel FM booster station could affect digital radio reception).

- GBS examined geo-targeting performance using "back-to-back" boosters that were placed so close to the road they were line of sight with the test vehicle, artificially confining the resulting interference, and then seeks to represent these results as applicable to much larger areas. This approach may display a lack of understanding of FM signal behavior.
- GBS examined interference only at highway speeds and along the most ideal route for crossing through the interference area (*i.e.,* at right angles to the transition area), while ignoring other more likely situations that will be unavoidable for many stations, such as routes that cut diagonally through the interference area or run tangentially along the boundary of the interference area. GBS also failed to consider stationary listeners and interference areas in the larger coverage area of the station and its FM1 booster.
- GBS failed to examine the enormous area of potential interference created by the ZoneCasting booster, instead implying without any supporting data that just "0.01617%" of roads will be affected.
- The test did not adequately test the impact of ZoneCasting on HD Radio.
- GBS invents an unsubstantiated "20% multipath threshold" to claim acceptability of ZoneCasting-degraded sound quality, instead of performing listener studies, as is recommended practice. GBS claims that "[L]isteners in FM transition zones experienced no material change."[21] However, there were no actual listeners involved in the KSJO(FM) test.
- GBS uses a methodology for measuring sound quality that is not intended for measuring the types of audio used in FM broadcasting and reception artifacts of associated with ZoneCasting interference.
- The test only covers a miniscule area, reflecting only a tiny percentage of the situations that stations will face in trying to design a booster system that prevents harm to listeners, and ignoring measurement within the coverage area of the primary station.
- GBS requested and was granted permission to include a high-powered booster in this test, but no mention of this booster is made in the KSJO(FM) Test Report. Exclusion of this booster is consistent with GBS's reliance on studying only miniscule areas.

As noted above, GBS's efforts to strategically design the KSJO(FM) test and spin the results do not conceal the fact that ZoneCasting will cause interference that will harm radio listeners. Overall, given the extremely narrow scope of this test and various reporting gaps, Mr.

[21] KSJO(FM) Cover Letter at 2.

Kean determines that the KSJO(FM) test is effectively useless.[22] Similarly, the ZoneCasting Tests Analysis identifies numerous problems with the test at WRBJ-FM:

- As with the KSJO test, GBS also schemed this test to create only the most glowing results by carefully placing back-to-back boosters in locations designed to minimize interference (adjacent to a highway), and presents these results as representative of ZoneCasting's impact over larger areas.
- GBS omits analysis of far more common scenarios that stations will definitely encounter and are more likely to cause interference.
- GBS again only studied the effects of ZoneCasting on the most favorable route for traversing the transition area (*i.e.*, at right angles to the transition area), while ignoring the impacts on listeners travelling diagonally through or tangentially to the areas of interference, or stationary listeners inside or near the examined transition area.
- GBS again failed to examine the effects of ZoneCasting in the larger coverage area of the primary station.
- GBS failed to examine the enormous area of potential interference created by the ZoneCasting boosters, instead implying without supporting data that "only 0.11%" of roads will be affected.
- Station WRBJ-FM has no digital capabilities, so this test adds nothing to address concerns about the impact of geo-targeting on HD Radio.[23]
- GBS repeats that "[l]isteners in FM transition areas experienced no material change,"[24] although no listeners were present during the test and no listening studies were conducted. Of note, GBS collected audio recordings during both tests, but did not make the recordings available for public or Commission review,[25] perhaps because doing so would frustrate its advocacy. Instead, GBS again summoned its phantom "20% multipath threshold" as a surrogate measurement of sound quality degraded by ZoneCasting.
- GBS may have violated the terms of the experimental authority granted to WRBJ-FM, as most of the tested boosters had different coordinates, power, antenna height, type, or orientation from the facilities that WRBJ-FM requested permission to test.[26] Neither Mr. Kean nor NAB could find evidence that GBS or WRBJ-FM received authority to modify the approved test facilities, and it is unclear when the test parameters were changed or why these differences were not reported to the

[22] ZoneCasting Tests Analysis at 9.

[23] NPRM, 35 FCC Rcd at 14220.

[24] WRBJ-FM Cover Letter at 3.

[25] WRBJ-FM Test Report at 20.

[26] *Id*. at 23-25.

FCC in the required experimental authorization final report or in the WRBJ-FM Test Report.

As with the KSJO(FM) test, GBS tries to obscure the interference caused by ZoneCasting during the WRBJ-FM test and the harm of such interference to radio listeners. In fact, the interference in the latter was even worse here because the test in Jackson did not benefit from natural terrain shielding as was the case with the San Jose station. The WRBJ-FM Test Report states that the area where ZoneCasting will cause interference may exceed 187 meters, or more than 600 feet, or longer than two football fields.[27] A listener travelling in a car at 25 mph, on the *most ideal* route for cutting through the interference area, could suffer disrupted radio service for about *16 seconds*. Overall, the ZoneCasting Tests Analysis concludes that the WRBJ-FM test, like the KSJO(FM) test, is incomplete, that the data GBS has chosen to report shows that ZoneCasting will cause unacceptable interference, and most importantly, such interference cannot be reliably prevented.[28] The ZoneCasting Tests Analysis thus determines that ZoneCasting is technically unsound and should not be permitted.[29]

NAB asks the Commission to see through GBS's smoke screens and reject GBS's proposal because it will harm listeners, as shown in the ZoneCasting Tests Analysis.

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[27] *Id*. at 29, Table 5.

[28] ZoneCasting Tests Analysis at 16

[29] *Illinois Citizens Committee for Broadcasting v. FCC*, 467 F.2d 1397, 1401 (7th Cir. 2005) ("[T]he FCC has important responsibilities to promote effective radio and television transmission throughout the country, and thus to minimize interference with radio and television signals. . .").

II. NEITHER THE KSJO(FM) NOR THE WRBJ-FM TESTS DEMONSTRATE THAT ZONECASTING IS TECHNICALLY SOUND

ZoneCasting technology is designed to create "zones" within a full-service radio station's coverage area in which distinct, geo-targeted content is broadcast to listeners using on-channel boosters. This requires overcoming the complex challenge of deploying, operating, and maintaining boosters in a manner that minimizes the objectionable interference caused by simultaneous reception of radio service from the station's main signal and the booster signal(s), for both analog and digital operations. As discussed below, the two recent GBS tests are hopelessly flawed and too narrowly focused to even begin to address concerns that ZoneCasting will cause unacceptable interference that will harm listeners.

A. Interference from ZoneCasting is not Limited to the Transition Area on the Border Between the Main and Booster Coverage Areas, as GBS Alleges

Readers of the GBS technical reports are asked to believe that the objectionable interference created by ZoneCasting is limited to so-called "transition areas" or "transition regions" which only exist along the perimeter of zone coverage areas, as shown in the rendering below from the WRBJ-FM Test Report.[30] Setting aside GBS's use of euphemisms for the areas where interference will occur, nothing could be farther from the truth.[31] GBS takes this position throughout as the basis of its test methodology, which is to report only the interference caused by geo-targeting on the zone boundary, and remarkably, at only one (KSJO(FM)) or two (WRBJ-FM) locations.[32]

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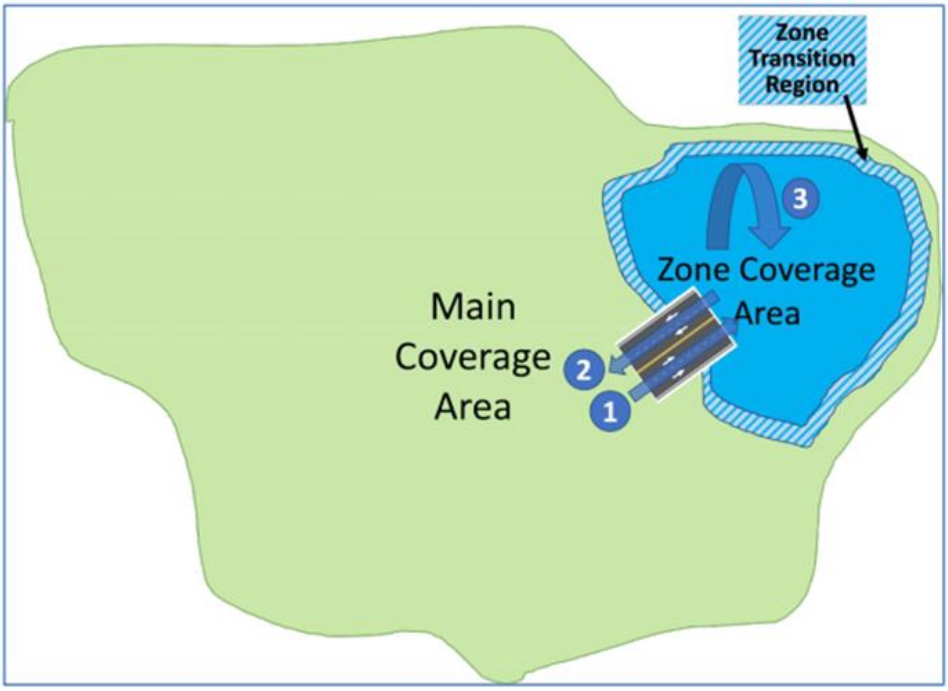
[30] WRBJ-FM Test Report at 2.

[31] KSJO(FM) Test Report at 11, Figure 4, labeling the "zone transition region" as the narrow cross-hatch shaded donut region completely encircling the Zone coverage area.

[32] KSJO(FM) Cover Letter at 1 ("Further, the report shows that the transition areas between zones -- which are entirely within the control of the broadcaster -- can be designed and programmed to take up a miniscule portion of a station's service area and be infrequent, transitory, unobjectionable, and in most cases unobservable to the listener.").

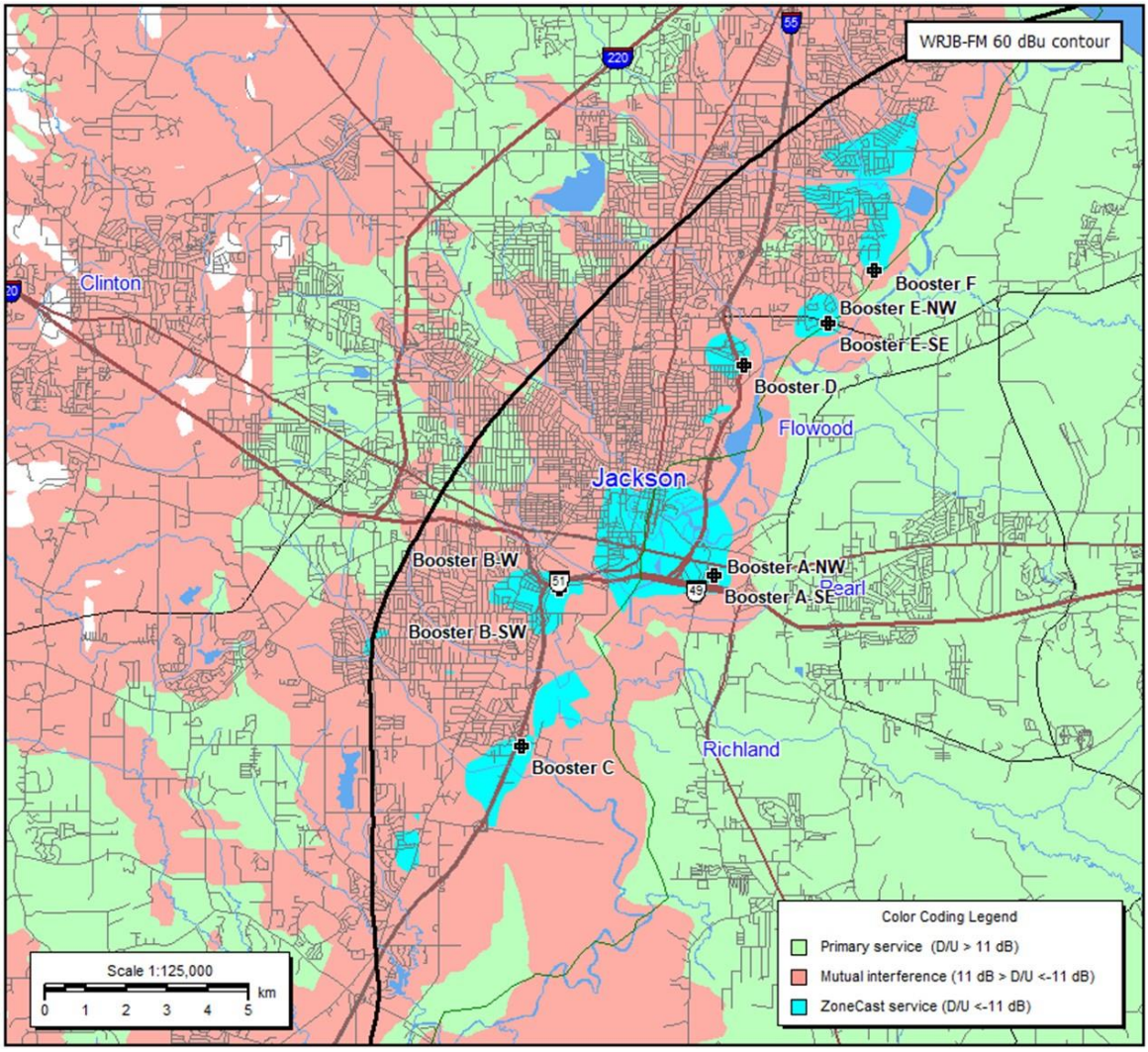


This narrow focus on interference behavior in only a narrow region encircling the zone belies the fact that, as the ZoneCasting Tests Analysis demonstrates, interference caused by the ZoneCasting boosters will be widespread and predictable outside that narrow region.[33] As defined by GBS, transition areas exist only where "the power of the localized zone signal is similar to the power of the main FM broadcast signal."[34] However, the ZoneCasting Tests Analysis clearly demonstrates that interference will occur over large areas and is not limited to the zone border. Both GBS reports totally ignore this fact and provide no test data or analysis to characterize this widespread predicted interference. This is not surprising because doing so would require GBS to acknowledge the truth about booster-generated interference and contradict its primary assertion that the expected interference from ZoneCasting is limited and controllable, when in reality it is neither.

[33] ZoneCasting Tests Analysis at 16

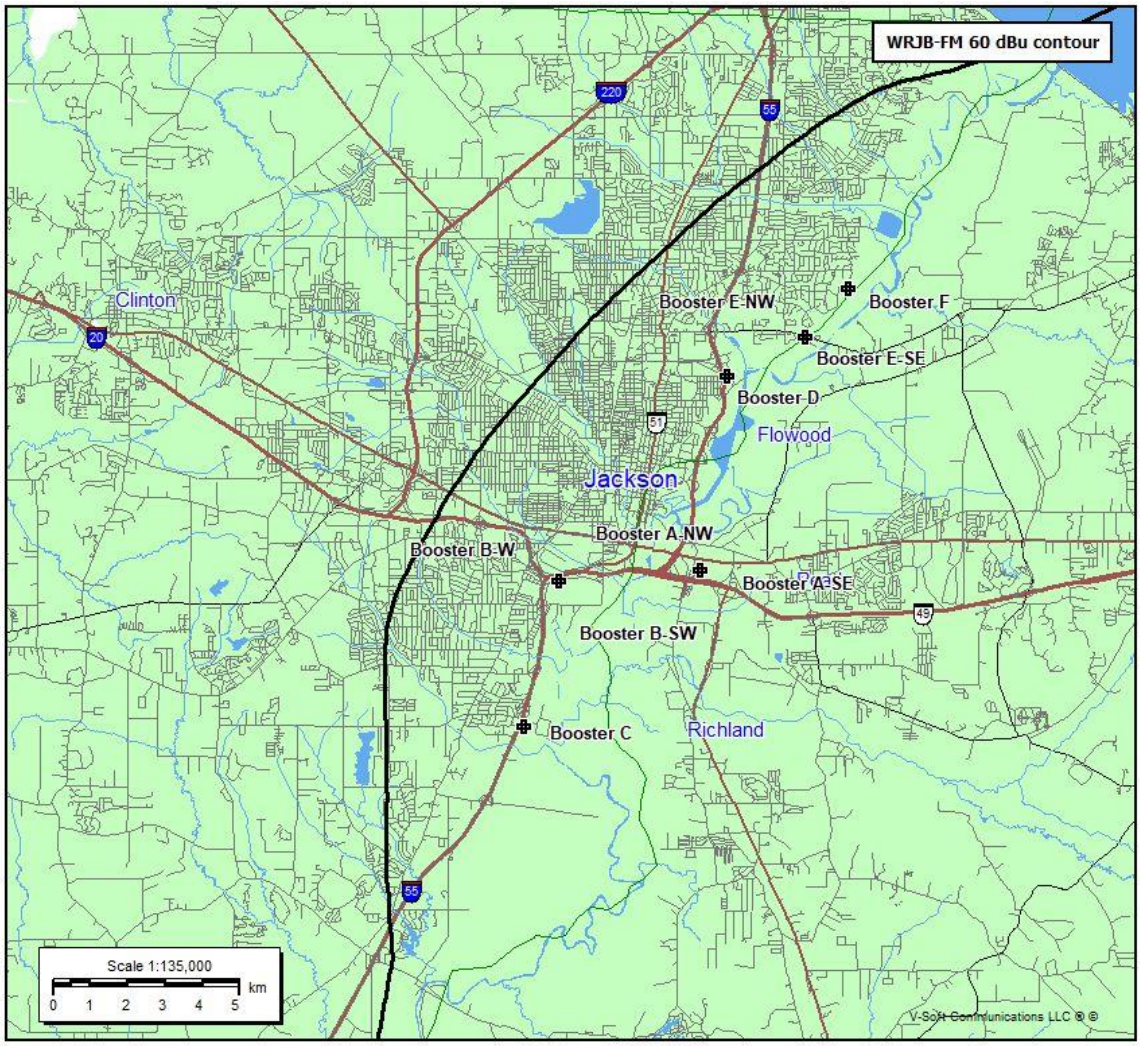
[34] WRBJ-FM Test Report at 2.

To appreciate the magnitude of the GBS deception, consider this map of a portion of the WRJB-FM coverage area (ZoneCasting Tests Analysis, Figure 10), which highlights in red the areas of interference within and surrounding the zone created by the boosters, which are of course responsible for the interference:



Mr. Kean generated this map using the engineering specifications of the WRJB-FM booster network provided in the WRBJ-FM Test Report (booster service contours have been omitted for clarity). This map clearly shows that, rather than a continuous narrow ring around each of the booster coverage zones, the transition region is discontinuous and widespread. The red areas of interference in this map represent an expected interference threshold ratio

of 11 dB D/U, which is 9 dB worse than allowed for co-channel interference under FCC allocation rules. For comparison, the same map as shown above was generated with the boosters turned off and is shown below. The absence of the red interference areas here highlights the deleterious effect of the boosters shown in the earlier map.



This situation, where a ZoneCasting booster is interfering with a main channel signal broadcasting different content at an 11 dB D/U ratio, was studied in 2013 by Mr. Kean while employed at NPR Labs, as part of a laboratory-based listening project for characterizing

listener opinions about ZoneCasting interference.[35] Mr. Kean, using a scientifically-based subjective evaluation listening study, determined that only 9% of listeners would keep listening to the type of signal depicted in the red regions above, and that the audio quality in these regions was found to have a mean opinion score (MOS) of 1.6, which is poor. This is a far cry from GBS's claims.

Returning to GBS's proffered data, Figure 4 in the KSJO(FM) Test Report is a stark illustration of the woeful inadequacy of GBS's data collection effort – a single route into and out of the zone coverage area, and nebulous, undocumented testing within the zone and in the terrain-shielded, strong signal area of the booster where no interference would reasonably be expected. Figure 4 also obscures GBS's attempt to "stack the deck" for the test routes labeled "1" and "2" by placing back-to-back, highly directional antennas right on top of where the measurements were made. Further, Figure 4 demonstrates GBS's myopia regarding the transition region as only existing along the perimeter of the zone, a misleading depiction as demonstrated in the many examples of predicted interference in the ZoneCasting Tests Analysis.

GBS inadvertently shines a light on the inadequacy of its own data when reviewing the transition area test data collected for the KSJO(FM) Test Report, obtained on a single stretch of highway (I-680) traversed multiple times. Table 5 of this report states that there are 621 km of roadway within the zone being studied and Figure 13 shows that there are multiple roadways crossing between the zone and main signal areas.[36] It is inconceivable that GBS would acknowledge the extent of the zone on the one hand but on the other hand provide

[35] ZoneCasting Tests Analysis at 3.

[36] KSJO(FM) Test Report at 25-26.

data on only a single, short route as evidence of acceptable performance for this ZoneCasting system. Essentially, GBS insults the Commission's ability to accurately assess the impact of interference caused by geo-targeting in this exercise.

It also bears mentioning again that the routes used for data collection in both tests are closely adjacent to a back-to-back booster installation, which by design will create an extremely short transition area and is wholly unrepresentative of the general architecture of ZoneCasting. This fact alone dooms both tests as all of the presented data only reflects the back-to-back booster-antenna configuration and not typical ZoneCasting behavior.

B. Subjective Evaluation Studies Which Form the Basis of GBS Testing are Mis-applied to ZoneCasting and Render Both Tests Useless

GBS repeatedly cites a subjective evaluation test program funded by GBS and conducted by NPR Labs and Towson University that was designed to establish the level of interference that listeners find objectionable, and purportedly establish a scientific basis for identifying the size of the transition area observed during the KSJO(FM) and WRBJ-FM tests. For example, GBS's initial Petition for Rulemaking states:

> The parameters for ZoneCasting were verified by simulations of transmitted FM signals at NPR Labs, and these simulation results were then evaluated by a large group of listeners in controlled subjective testing at Towson University. These parameters define the RF interference (C/I+N) ratios in both stereophonic and monophonic FM transmission, for fixed and mobile reception. Extensive network design work at NPR Labs was used to identify the power and height for the ZoneCasting boosters under a variety of primary station types and terrain conditions. By using appropriate parameters for each of main transmitter and each of the boosters, harmful interference within the target area of the zone can be effectively eliminated.[37]

In the course of preparing these comments, NAB has learned that GBS's claimed scientific basis for eliminating harmful interference caused by ZoneCasting, based upon data purportedly obtained by NPR Labs, does not exist. On the contrary, there exists a set of data,

[37] GBS Petition at 8.

never publicly disclosed until now, produced by NPR Labs at the behest of GBS back in 2013, which focuses on the performance of ZoneCasting in transition areas. This data proves that the performance of ZoneCasting is poor and objectionable to listeners.

The ZoneCasting Tests Analysis provides details of the testing conducted by NPR Labs on behalf of GBS. In sum, in 2013, NPR Labs worked with Towson University to study both ZoneCasting and simulcast single-frequency network (SFN, referred to by GBS as MaxxCasting) booster signal reinforcement. The test results on the MaxxCasting SFN configuration, published in the *Proceedings of the 2013 NAB Broadcast Engineering Conference*, demonstrated that when properly implemented, a simulcast booster can improve reception without creating widespread, excessive interference. On the other hand, the test results regarding ZoneCasting were never published, and interestingly, never referenced by GBS in any of its submissions to the FCC. These results, some of which are included in ZoneCasting Tests Analysis, demonstrated that ZoneCasting would cause unacceptable interference to listeners,[38] and never used as claimed by GBS to "identify the power and height for the ZoneCasting boosters under a variety of primary station types and terrain conditions."

C. No Listening Tests are Included in Either Test Report and the Objective Listening Test Measure Used by GBS is Misapplied to ZoneCasting

The opinion of listeners is the most important factor in evaluating the impact of RF interference on FM radio listening. Subjective evaluations, in which audio recorded under the interference conditions of interest is collected and presented to a statistically significant number of qualified listeners in a structured and scientifically-based manner, are used to assess the impact of the interference.

[38] ZoneCasting Tests Analysis at 4.

It is notable, but not surprising, that neither of the GBS reports includes any listener-based data. In lieu of asking listeners to assess the audio quality while in a transition area, GBS relies on an objective measurement method, "POLQA Assessment," which they applied to audio samples obtained in regions of high "multipath" as established by the Roberson test gear.[39] This evaluation process is twice doomed as Roberson misapplies both the POLQA assessment and the multipath measurement characterization, rendering the data presented in the reports as highly questionable if not completely unusable. As explained in the ZoneCasting Tests Analysis: "[The authors] do not appear to realize that ZoneCasting involves an entirely different version of program audio from the host station's primary signal, which is properly called co-channel interference – not 'multipath.'"[40]

The POLQA audio quality measurement tool is designed around an ITU-T recommendation, P.863, which cautions that there are a number of "factors not validated" which are factors the measurement tool has not been shown to work with. A number of these factors, including "multiple simultaneous talkers" and "music input to a codec" are highly relevant to and likely to be found in the audio samples collected by Roberson.[41] As noted above, actual listening tests relevant to ZoneCasting were conducted by NPR Labs in 2013 and, as described in the ZoneCasting Tests Analysis, revealed that listeners were highly critical of the audio impairments created by the sort of interference that is created by ZoneCasting. Interviews with the listeners revealed that "the intermittent 'break-in' of the

[39] Roberson teases offering insight into their ideas regarding the use of multipath measurement in the KSJO(FM) report, stating, "Although a few parameters have utility in this domain, the multipath measurement is clearly the most reliable and useful (see Appendix E)," however, no Appendix E is included in the report. KSJO(FM) Test Report at 18.

[40] ZoneCasting Tests Analysis at 18.

[41] *Id*.

primary audio by different content from the ZoneCasting signal was far more annoying than equal-level bursts of neutral noise and distortion in the audio."[42] It is telling that GBS elected to never reveal these NPR Labs ZoneCasting test results nor ever referred to them in their numerous FCC filings.

D. HD Radio Testing Documented in the GBS Test Reports is Completely Inadequate and Leaves Open Numerous Critical Questions

GBS has conducted an extremely limited amount of testing of ZoneCasting using HD Radio digital radio signals. Moreover, such testing was performed only during the KSJO(FM) test, with no additional testing during the more complex deployment tested at WRBJ-FM, even though numerous questions regarding ZoneCasting's effect on HD Radio remained unaddressed after the KSJO(FM) test. Xperi, which developed HD Radio, remains extremely concerned about ZoneCasting,[43] as do radio broadcasters that have invested heavily in digital radio facilities.[44]

Incredibly, by observing HD Radio performance on a single test route, right next to a location utilizing back-to-back directional booster antennas which guarantee an unnaturally sharp transition area, GBS concludes that the "HD1 transition size is at least an order of magnitude smaller than that for analog FM and is, in effect, instantaneous and therefore unmeasurable."[45] This conclusion is unreasonable and unsupported by the KSJO(FM) test. It is unimaginable and may contradict the most basic tenets of scientific practice to reach such

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[42] *Id*. at 19.

[43] Xperi Comments at 6.

[44] Joint Reply Comments of Beasley et al at 6-9, MB Docket Nos. 20-401 and 17-105, and RM-11854 (Mar. 12, 2021).

[45] KSJO(FM) Test Report at 20 and 28.

a sweeping conclusion based on virtually no evidence.[46] It is also absurdly convenient because GBS admits that the only measure of transition areas used in its reports, the so-called "multipath threshold" measurement, is inapplicable to HD Radio signals. Therefore, GBS should have used an appropriate method to conduct any HD Radio measurements.[47]

Furthermore, while the KSJO(FM) Test Report describes the audio and HD Radio reception indicator behavior of the receiver as the transition area is traversed, brief and only dubious mention is made of the metadata behavior,[48] despite the apparently significant efforts undertaken by GBS to observe and document such metadata. Specifically, GBS claims that it has "collected GoPro video files for the zone transitions across numerous vehicles."[49] In today's "connected cars," the content, quality and dependability of radio station metadata are critical factors as radio broadcasters compete directly on the dashboard with internet-sourced audio services that set new standards for consistent and relevant metadata that listeners demand.

The KSJO(FM) Test Report distills the results of these metadata observations down to a series of three figures showing a single receiver display and allegedly demonstrating that the metadata did not change while the receiver was traversing the transition area.[50] The last

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[46] *Code of Ethics for Engineers*, National Society of Professional Engineers, available at https://www.nspe.org/resources/ethics/code-ethics.

[47] KSJO(FM) Test Report at 19 (stating that "it is not feasible to set a meaningful multipath threshold for estimating HD Radio transition region size. This is because there is no discernable relationship between the multipath value and perceived audio quality [in the HD Radio signal].").

[48] *Id*. at 30.

[49] *Id*. GBS contends earlier in the report, in their description of the testing research conditions and methodology, that test radios included ". . . models from different manufacturers which were outfitted with the equipment to measure received signal and audio/video/Metadata quality for the FM and HD Radio signals." KSJO(FM) Cover Letter at 2.

[50] KSJO(FM) Test Report at 31, Figures 17-19.

figure purports to show metadata particular to the zone transmission and hence serves as evidence of reception of the HD Radio zone transmission; however, the "HD indicator" highlighted in the first figure in the series, is suspiciously absent from the figure supposedly showing reception of the Zone-based HD Radio signal. NAB has conducted extensive metadata investigations in the field using automotive receivers and has observed a wide variation in metadata behavior, and based on this experience, finds it beyond credulity that the meager discussion in the KSJO(FM) report could accurately capture the transition area metadata behavior if GBS's test are in fact accurately described in the test report.

Nor is digital multicast channel performance acceptable, even under the unrealistic scenario tested at KSJO(FM). Not surprisingly, the multicast channel audio muted while the transition area was traversed, resulting in seven seconds of silence. The conclusion reached in the report is that the main signal and booster signal "Exporters" need to be synchronized, indicating that: "Efforts are underway to develop means to synchronize HD Exporters that could reduce the duration of HD2 signal loss."[51] Absent such developments and reliable operations, ZoneCasting will have a devastating impact on digital radio service, to the detriment of both listeners and stations.

III. THE ZONECASTING TESTS AT KSJO(FM) AND WRBJ-FM PROVE THAT ZONECASTING SHOULD NOT BE AUTHORIZED

Prior to the ZoneCasting test at KSJO(FM), the only test of ZoneCasting referenced by GBS that may have any relevance was conducted in 2016 at WIIL(FM) in Milwaukee, Wisconsin, although it remains unclear whether this test used a previous or current version of ZoneCasting. Either way, GBS made it virtually impossible for the public to assess this exercise by failing to address or define certain important parameters, such as listeners' opinions of the

[51] *Id*. at 29.

sound quality degraded by ZoneCasting and the routes or speed of the test vehicle. Yet, despite these gaps, and GBS's testing of only conditions that supported its advocacy, the WIIL test still revealed troubling interference along three driving routes through the areas where the contours of the station's main signal and booster met that lasted from 12 to 30 seconds.[52] Interference to this degree will clearly cause significant disruption to listeners.

Nothing in the more recent tests at KSJO(FM) or WRBJ-FM resolves this problem. To the contrary, these tests only confirm the serious harm that allowing geo-targeting using FM boosters will cause listeners. As described above, GBS has only examined back-to-back boosters located very close to a highway and tested for interference along only the most ideal driving routes for traversing the interference area, and only at high speeds. In addition, both KSJO(FM) and WRBJ-FM offered uniquely favorable conditions, as the former test area enjoyed natural terrain shielding that helped to limit the interference caused by ZoneCasting, and the latter test areas are located in a fairly unpopulated area. Moreover, it seems that GBS may have only submitted data that supported its wished-for results.[53] And at WRBJ-FM, GBS apparently tested using booster facilities that differed from those authorized by the FCC.

In addition, although GBS characterizes ZoneCasting's effect on listeners as immaterial,[54] there were no listeners present during either test and listeners have never rated any of the audio samples obtained during the test. Nor has GBS conducted industry-standard listening studies. GBS collected audio recordings of both tests but declined to submit them for

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[52] Beasley et al. Comments at 9-12.

[53] The KSJO(FM) Test Report states: "The zone transition region was traversed over 60 times at variable speeds and at various times of day using several vehicle makes/models, with 32 randomly selected for transition length measurements." The implication is that 28 examples of audio quality in the transition area were set aside. KSJO(FM) Test Report at 2.

[54] WRBJ-FM Cover Letter at 3.

review by the FCC or the public.[55] Even more damning, it appears that almost a decade ago, GBS squashed and misrepresented listening studies conducted by NPR Labs that proved ZoneCasting causes objectionable interference to listeners.[56]

At the same time, GBS leaves unanswered many critical technical questions asked by the FCC and industry stakeholders. For example, what would a listener experience as they travel near or along the intersection between two zones while the primary station and booster are airing different content, and how would stationary listeners located in homes near this intersection be impacted?[57] Or how will ZoneCasting impact radio listening throughout a station's listening area, given that GBS has only studied a miniscule portion of the KSJO(FM) and WRBJ-FM service areas, and what will be the impact of ZoneCasting on listeners travelling away from the primary signal on the far side of a booster?[58]

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[55] WRBJ-FM Test Report at 20.

[56] GBS has tried to compare ZoneCasting's alleged consumer benefits with those allowed by the geo-targeting of programming by cable TV or potentially ATSC 3.0. Comments of GBS at 3, MB Docket Nos. 20-401 and 17-105, and RM-11854 (Feb. 10, 2021). These services are completely inapposite. Unlike radio listeners, most viewers of these services are stationary, and the service they receive is static. Viewers do not experience any disruption caused by the transition of content delivery from one transmission system to another. They may receive programming from one or the other, but never both at the same time. To the extent that Distributed Transmission Systems may be used in ATSC 3.0, handoffs between transmitting nodes are seamless due to the inherent design of the system, which uses Orthogonal Frequency-Division Multiplexing (OFDM) rather than FM modulation. OFDM encodes data on multiple carrier frequencies, allowing it to cope with severe interference, including self-interference between multiple transmitting sites. This is not possible with FM, which is a single carrier system. On the other hand, most radio listening occurs while people are driving, meaning that listeners will be exposed to ZoneCasting's disruption as their radio reception bounces from the primary signal to a booster with different content. Unlike TV viewers at home, the interference imposed by ZoneCasting will be unavoidable and likely take listeners by surprise.

[57] NPRM, 35 FCC Rcd at 14217.

[58] Beasley et al. Comments at 15-16

All of these efforts to manufacture the best results render both the KSJO(FM) and WRBJ-FM tests useless, and certainly not worthy of an expert agency's reliance to advance GBS's proposal. We further note that GBS's testing to date pales in comparison to that normally conducted or required before a new technology is authorized, such as all-digital AM, hybrid (analog plus digital) HD Radio, or digital television. Nevertheless, even this insufficient amount of analysis demonstrates that "the magnitude of potential interference to the primary (host) FM station is great and largely unavoidable," and "that ZoneCasting™ cannot compensate sufficiently for its harm and therefore is broadly unsuitable for FM radio broadcasting."[59]

If the public's interest is driving this proceeding (i.e., listeners), then the Commission's conclusion should be very straightforward. There is simply no way GBS has met its burden to demonstrate that its service will not cause harm, even if the Commission considered only GBS's cherry-picked results. And the notion that somehow this matters less because the proposal only seeks to authorize and not require using GBS's technology is misplaced. It will be of little solace to consumers who lose clear radio service for ten or 25 or even more seconds as they travel through an area where their favorite station's signal bounces from the primary station to a booster and then possibly back to the primary station or another booster. Most listeners will quickly become confused and annoyed, and question whether the problem stems from the station, FM radio service, or their car. The Commission should not permit such an outcome, and definitely not do so based on the flimsy, misleading, and inaccurate technical data provided by GBS.

[59] ZoneCasting Tests Analysis at 16.

IV. CONCLUSION

For the reasons stated above, NAB submits that the costs to consumers of allowing ZoneCasting far outweigh the hypothetical benefits suggested by GBS. Accordingly, we respectfully ask the Commission to dismiss GBS's proposed rule change that would authorize program origination using boosters.

Respectfully submitted,

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