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

In the Matter of	)	
	)	
Petition for Rulemaking Requesting Authority	)	RM-__________
to Increase the Maximum Power	)	
of Digital FM Radio	)	

PETITION FOR RULEMAKING

The National Association of Broadcasters ("NAB")[1] and Xperi Inc. ("Xperi")[2] (collectively, "Petitioners"), pursuant to 47 C.F.R. §1.401(a), hereby petition the Commission to initiate a rulemaking proceeding to amend its rules governing in-band/on-channel ("IBOC") digital audio broadcasting. Petitioners request that the FCC adopt an updated formula to determine FM power levels for stations seeking to exceed the currently authorized FM digital ERP of -14 dBc. The proposed new formula, which is based on real-world, operational experience gained since the Media Bureau last approved a power increase in 2010,[3] will allow more stations to increase digital power above the existing -14 dBc level, without the need for separate FCC authorization. Approving this request will serve the public interest by improving digital FM coverage and digital FM signal penetration of buildings while continuing to minimize the probability of harmful interference to adjacent channel stations.

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[1] 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.
[2] Through a series of corporate transactions in 2015 and 2016, iBiquity Digital Corporation ("iBiquity"), the original developer of the in-band/on-channel technical system supporting the digital audio broadcasting service, is now a subsidiary of Xperi Inc. HD Radio™ is a trademark of iBiquity.
[3] *Digital Audio Broadcasting Systems and Their Impact on the Terrestrial Radio Broadcast Service*, Order, 25 FCC Rcd 1182 (2010) (2010 Order).

This Petition dovetails with a request filed in 2019 for a rulemaking proceeding to permanently authorize FM radio stations to utilize IBOC with asymmetric sideband power levels without the need for separate or experimental authorization.[4] Petitioners specifically request that these two petitions be combined into one rulemaking proceeding. As explained in greater detail below, a blanket authorization of asymmetric sidebands, especially when combined with the new power level formula proposed herein, will enable many more FM stations to maximize service for their listeners.

I. BACKGROUND

Radio broadcasters and receiver manufacturers have continued to roll out digital audio broadcasting technology ("HD Radio™") at a steady pace since the Commission first authorized digital broadcasts in 2002.[5] The vast majority of digital receiver sales are tied to the purchase of new passenger vehicles. Forty-one automobile manufacturers offer over 413 vehicle models with factory installed HD Radio receivers, with 193 models including HD Radio technology as a standard feature. As of June 2022, over 59 percent of all new vehicles delivered nationally contained a factory-installed HD Radio receiver (see Figure 1) and the number of HD Radio-equipped cars (HDEC) in some radio markets exceeds 40 percent (see Figure 2). To date, more than 90 million existing vehicles have a digital receiver. Broadcasters have converted nearly 2,600 radio stations in the United States to

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[4] National Association of Broadcasters, Xperi Corporation, and National Public Radio, Inc., Petition for Rulemaking to Authorize Digital FM Inc. Asymmetric Sideband Operation, RM-11851 (filed Dec. 9, 2019) (2019 Sideband Petition).

[5] *Digital Audio Broadcasting Systems and Their Impact on the Terrestrial Radio Broadcast Service*, First Report and Order, 17 FCC Rcd 19990 (2002) (First Report and Order).

digital broadcasts and offer nearly 2,200 additional multicast channels using digital technology.[6]

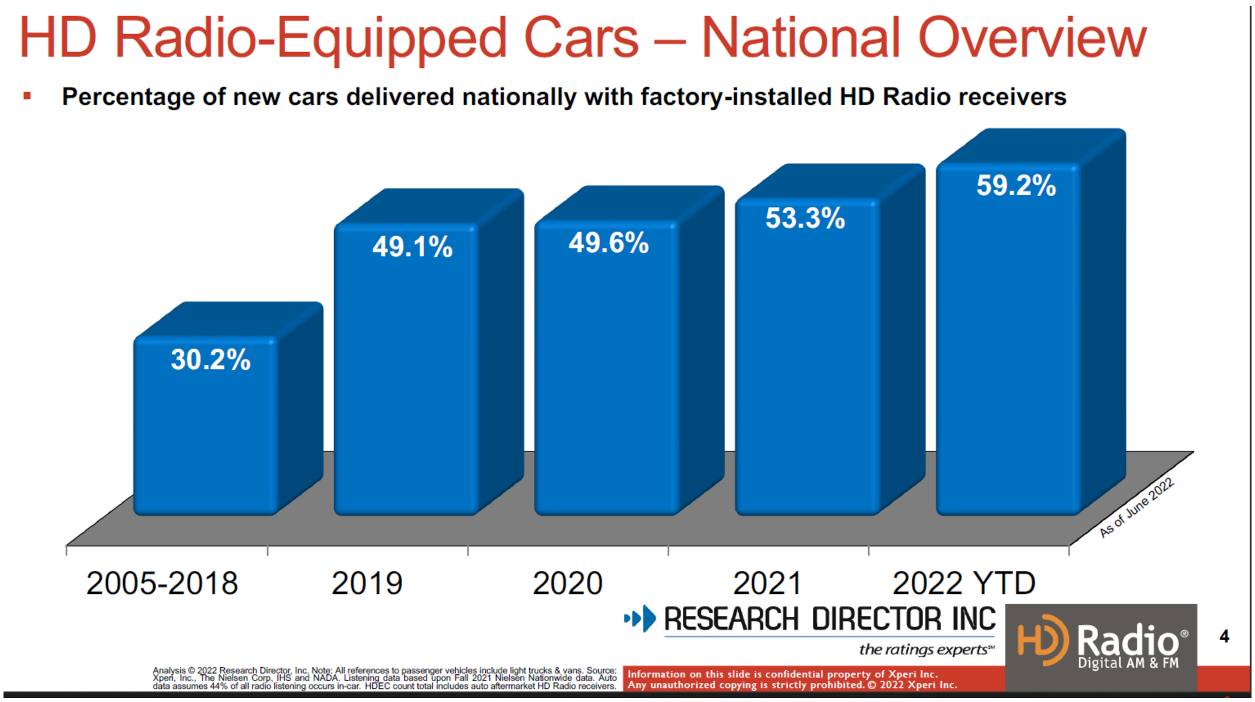

Figure 1. HD Radio new automobile receiver penetration (Source: Xperi Inc.)

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[6] Statistics compiled by Xperi.

HD RADIO BY THE NUMBERS HD Radio®

HIGHEST HD RADIO AUTO PENETRATION DMAS

GEOGRAPHY MEASURED	TOTAL # HDEC* IN DMA	TOTAL % HDEC* IN DMA
Springfield-Holyoke DMA	145,956	48.8%
New York DMA	7,142,420	45.8%
Detroit DMA	1,814,085	43.8%
Miami DMA	1,916,035	42.6%
Los Angeles DMA	6.092,518	42.5%
Burlington DMA	336,005	42%
West Palm Beach DMA	854,059	41.2%
Baltimore DMA	818,615	40.3%
San Francisco DMA	2,446,267	39.8%
Boston DMA	2,264,443	34.8%

Through June 2022. *HDEC = HD Radio-equipped cars.

Figure 2. HD Radio highest market penetration (Source: Xperi Inc.)

While digital receiver sales have dramatically increased in the past five years, station conversions have not experienced the same growth. Although many factors influence a station's decision regarding digital conversion, the Petitioners submit that a significant contributor to the slower station adoption rate is the frustration of many stations that are unable to fully replicate their analog coverage using the power levels permitted under the existing rules. Regulatory relief in the form of a blanket authorization of asymmetric sidebands and the adoption of a newer, more market-based formula for assessing digital interference risk will help encourage greater station adoption of the technology. This will also allow broadcasters to keep up with the growth in receiver sales and better serve the public interest through high quality local radio service. An increase in the rate of station conversions also will encourage transmission equipment manufacturers to continue to invest in the development of HD Radio equipment, thereby reducing equipment costs and expanding the range of stations that can afford to convert to digital broadcasts. Accordingly, adoption of the proposals set forth in this Petition is an important step that will benefit all sectors of the digital radio broadcast ecosystem.

In the First Report and Order, the Commission authorized FM stations to operate with digital ERP equal to one percent of analog power or -20 dBc.[7] In the 2010 Order, the Media Bureau modified Section 73.404(a) of the Rules to allow all FM IBOC stations to operate at -14 dBc and to allow stations that meet certain guidelines to increase further to -10 dBc (ten percent of analog power).[8] In some cases, to operate above -14 dBc, stations must submit an informal request to the Media Bureau.[9] The informal request must include an analysis of the station's potential to cause harmful interference to adjacent channel analog signals using the following formula that National Public Radio (NPR) developed in 2009 and that iBiquity Digital Corporation ("iBiquity") endorsed at the time:[10]

Allowable IBOC power = [2.27 * (60 - (IBOC station F(50,10) dBμ)) - 33.6]

Consistent with the Advanced IBOC Coverage and Compatibility Study (AICCS) Project Report, the FCC mandates that all stations calculate this formula using the station's analog F(50,10) field strength at all points on the 60 dBμ F(50,50) contour of the desired station without regard to the actual class of station or protected contour for the station.[11] Once the most restrictive (that is, strongest) analog F(50,10) field strength of the proponent station

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[7] First Report and Order at ¶ 40; *see also* 47 C.F.R. §73.404(a).
[8] 2010 Order at ¶ 20*; see also* 47 C.F.R. §73.404(a).
[9] *Id*.
[10] *Report to the CPB and FCC on the Advanced IBOC Coverage and Compatibility Study*, NPR (filed Nov. 24, 2009) at Appendix J ("AICCS Project Report"); *see also* 2010 Order at ¶ 8.
[11] 2010 Order at ¶¶ 11-15.

has been determined, the licensee uses the following table (derived from the formula above) to determine the proponent station's maximum permissible FM digital power:[12]

Proponent Analog F(50,10) Field Strength at Desired Analog 60 dBμ F(50,50) Contour	Maximum Permissible FM Digital ERP
51.2 dBμ and above	-14 dBc
50.7 dBμ to 51.1 dBμ	-13 dBc
50.3 dBμ to 50.6 dBμ	-12 dBc
49.6 dBμ to 50.2 dBμ	-11 dBc
49.5 dBμ or less	-10 dBc

Over the past 12 years, concerns have developed about this approach. First, the approach assumes symmetric rather than asymmetric digital sidebands. The use of symmetric sidebands for all calculations eliminates a viable path for many stations to increase power on at least one sideband, which would improve digital coverage. Second, as is discussed in more detail below, the existing formula is too restrictive. Practical experience since 2010 has shown that the formula overstates the level of protection analog stations require. Taken together, these overly conservative factors reduces the number of stations that might increase power. The updated formula proposed herein, coupled with the earlier proposal to allow stations to use asymmetric sidebands on a blanket basis, would address these concerns.

[12] *Id*. at 9. Note that the word "protected" has been struck from the first column heading in the table to emphasize that the 60 dBu contour is the contour of interest regardless of station class.

II. THE PROPOSED RULE CHANGES WILL SERVE THE PUBLIC INTEREST IN IMPROVED RADIO SIGNAL QUALITY

To address these concerns, the formula used for calculating allowable IBOC power should be changed to:[13]

> Allowable IBOC power (dBc, total power) = 44 – [IBOC Station F(50,10) dBµ at the desired station 60 dBµ F(50,50) contour]

or if using asymmetric sidebands:

> Allowable IBOC power (dBc, per sideband) = 41 – [IBOC Station F(50,10) dBµ at the desired station 60 dBµ F(50,50) contour]

These formulas would be applied in the same manner as the existing formula, namely, to determine the highest analog F(50,10) contour value for the proponent IBOC station tangent to the analog 60 dBu F(50,50) contour of the 1st-adjacent (protected) station and then apply the appropriate formula. A table for determining the allowable IBOC power ratio is provided below and includes a comparison with the values in the current table:

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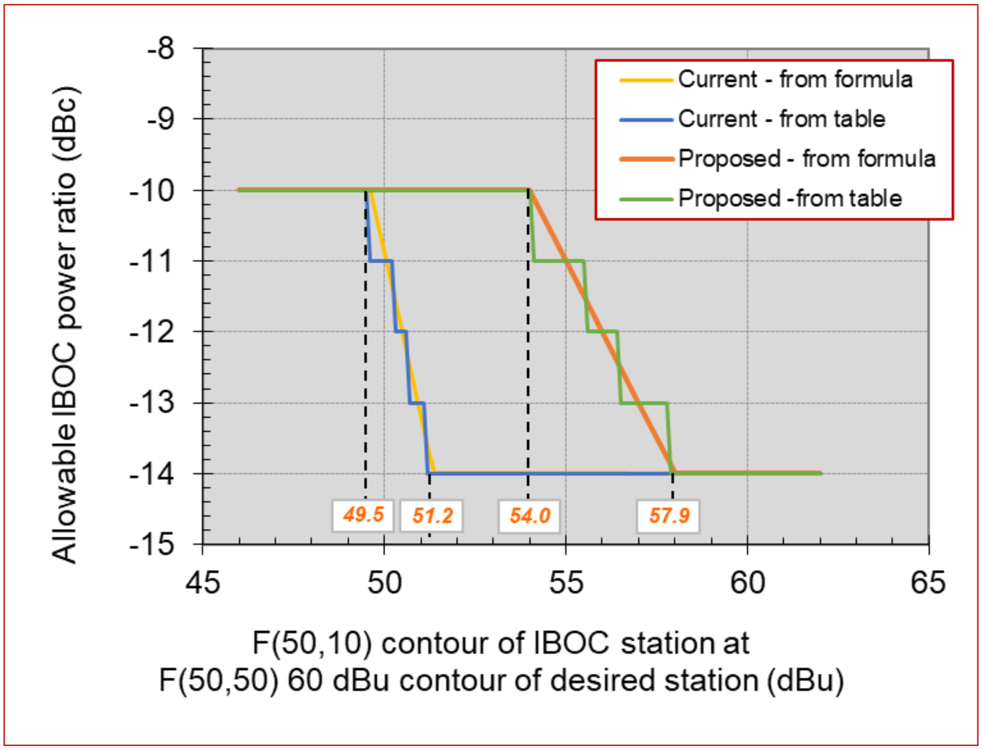
[13] It is important to distinguish between "total power" and "sideband power." Total power refers to the total integrated power of both primary digital sidebands. When power is calculated for each sideband individually, sideband power is 3 dB less that total power. Thus, a total power of -14 dBc would mean the upper and lower digital sidebands each operate at -17 dBc. If the station operates at -10 dBc total power, it would have -13 dBc sideband power for each sideband. More information on this topic is available in Table 2 of NRSC-G202-A FM IBOC Total Digital Sideband Power for Various Configurations guideline. *See* https://www.nrscstandards.org/standards-and-guidelines/documents/guidelines/g202-a.pdf.

Proponent analog F(50,10) field strength at desired analog 60 dBu F(50,50) contour			Maximum permissible FM digital ERP
Current (dBu)	Proposed (dBu)	Change (dB)	(dBc)
51.2 and above	57.9 and above	6.7	-14
50.7 - 51.1	56.5 - 57.8	5.8	-13
50.3 - 50.6	55.6 - 56.4	5.3	-12
49.6 - 50.2	54.1 - 55.5	4.5	-11
49.5 or less	54 or less	4.5	-10

A graphical representation of these formulas is illustrative and is shown here:



This graph highlights the similarities between the current and proposed methods and depicts how the proposed increase in allowable IBOC power at the F(50,10) contour of the desired station is reduced as the IBOC power increases (when compared to the currently allowed increase).

Adoption of these proposals would advance the goals the Media Bureau articulated in the 2010 Order: "to improve FM digital coverage and to eliminate regulatory impediments to FM digital radio's ability to meet its full potential and deliver its promised benefits."[14]

The proposed formula better reflects the real-world interference environment in the FM band and the appropriate level of protection that 1st-adjacent stations need from harmful interference.[15] We also believe the current formula overstates the potential for digital interference and has constrained stations from increasing power, which has constrained digital service.

Our conclusion that the existing formula has been too restrictive should not surprise the Commission. In the 2010 Order, the Media Bureau itself noted a concern that the formula was too conservative.[16] Notwithstanding that concern, the Bureau deferred to industry based on the strong consensus at the time in support of the current conservative formula, which allowed for over a decade of practical experience. The radio industry's experience since 2010 has validated the Bureau's prescient concern, and it believes that the time is right to revisit the issue. The current rules discourage many stations that would not cause harmful interference, but that do not comply with the existing formula, from seeking to increase power above the -14 dBc level. This includes stations that are fully spaced. Stations that cannot comply with the existing formula have been unwilling to

[14] 2010 Order at ¶ 13.

[15] The Commission could consider adding a notification procedure whereby a broadcaster electing to increase power above -14 dBc informs 1st-adjacent channel neighboring stations of the change when it is made.

[16] *Id*. at ¶ 19 ("The Bureau's experience with higher power digital experimental authorizations suggests that the formula developed by NPR and endorsed by iBiquity in the Agreement is overly-predictive of the potential for interference.").

assume the administrative burden of showing noninterference. Instead, they accept the coverage constraints on their digital broadcasts.

The Petitioners have conducted an engineering study examining whether the overall interference levels embodied in the current formula realistically capture the threat of harmful interference from digital stations operating at higher power levels.[17] As detailed further in Appendix 1, Xperi and NAB, working with engineers from radio broadcast group owners Audacy, Inc. (Audacy) and iHeartMedia, Inc., examined a number of short-spaced station pairs where the digital station operates at -14 dBc. Because nearly all stations are permitted to increase digital power to -14 dBc without the need to consider the formula, Xperi and NAB realized there are stations operating at -14 dBc where the digital signal level at the adjacent channel protected contour greatly exceeds the limits in the current formula. The study identified many stations currently operating at -14 dBc that exceed the interference levels the current formula would prohibit for stations seeking to operate above -14 dBc. However, even with those elevated levels of potential digital interference, there have been no well-documented reports of interference by any of those stations. Thus, the Petitioners concluded that the formula was restricting increases in digital power even at levels that would not cause harmful interference.

Under the existing formula, stations operating at -14 dBc would have a F(50,10) field strength of approximately 51.4 dBµ at the 60 dBµ F(50,50) contour of a 1st-adjacent analog station.[18] This can also be expressed as approximately an 8.6 dB desired-to-undesired (D/U) ratio between the analog and digital stations.[19] In other words, the current formula assumes

[17] See Appendix 1, which is a presentation given at the 2017 IEEE Broadcast Symposium.
[18] 2.27 x (60-51.4) -33.6 = -14.
[19] 60 – 51.4 = 8.6.

that when the 51.4 dBμ F(50,10) contour of the digital station is tangential to the 60 dBμ F(50,50) contour of the first adjacent analog station (or where there is a 8.6 dB D/U ratio), the risk of harmful digital interference becomes unacceptable, and the digital station may not further increases its digital power. The Xperi/NAB study looked for examples of stations that have a digital signal level greater than 51.4 dBμ at the point that the F(50,10) contour of the digital station is tangential to the 60 dBμ F(50,50) contour of the first adjacent analog station (or equivalently, where there D/U ratio is worse than 8.6 dB). In those cases, the study found no reports of harmful interference. A few examples of these types of station pairs are presented below with differences summarized in this table:[20]

IBOC station at -14 dBc (undesired)	Analog station (desired)	Actual F(50,10) (dBu)	F(50,10) permitted under current formula (dBu)	Difference - current formula (dB)	F(50,10) permitted under new formula (dBu)	Difference - proposed formula (dB)
WKTU	WPRB	72.8	51.4	21.4	58	14.8
KFRG	KBZT-FM	63.7		12.3		5.7
WJFK	WWMX	71.5		20.1		13.5
WJFK	WWEG	75.6		24.2		17.6
WBAV	WJMH	58.9		7.5		0.9

Figure 3 below shows the overlap of WKTU-FM, a Class B station located in New York City, with WPRB-FM in Princeton, New Jersey. WKTU currently operates its digital sidebands at -14 dBc total power or -17 dBc per sideband power. WKTU's 72.8 dBμ F(50,10) interfering contour is tangential to WPRB's 60 dBμ F(50,50) contour. *This is 21.4 dB above the 51.4 dBμ level that is dictated by the existing formula*. The D/U ratio for these stations would be -12.8 dB, *which is 21.4 dB worse than the D/U ratio permitted under the existing*

[20] Note that for all of the digital stations in the example cases presented, the allowable IBOC power under the proposed formula would still be -14 dBc.

formula. Despite the significant amount of interference that would be predicted from the existing formula, there have been no reports of actual interference from WKTU into WPRB.

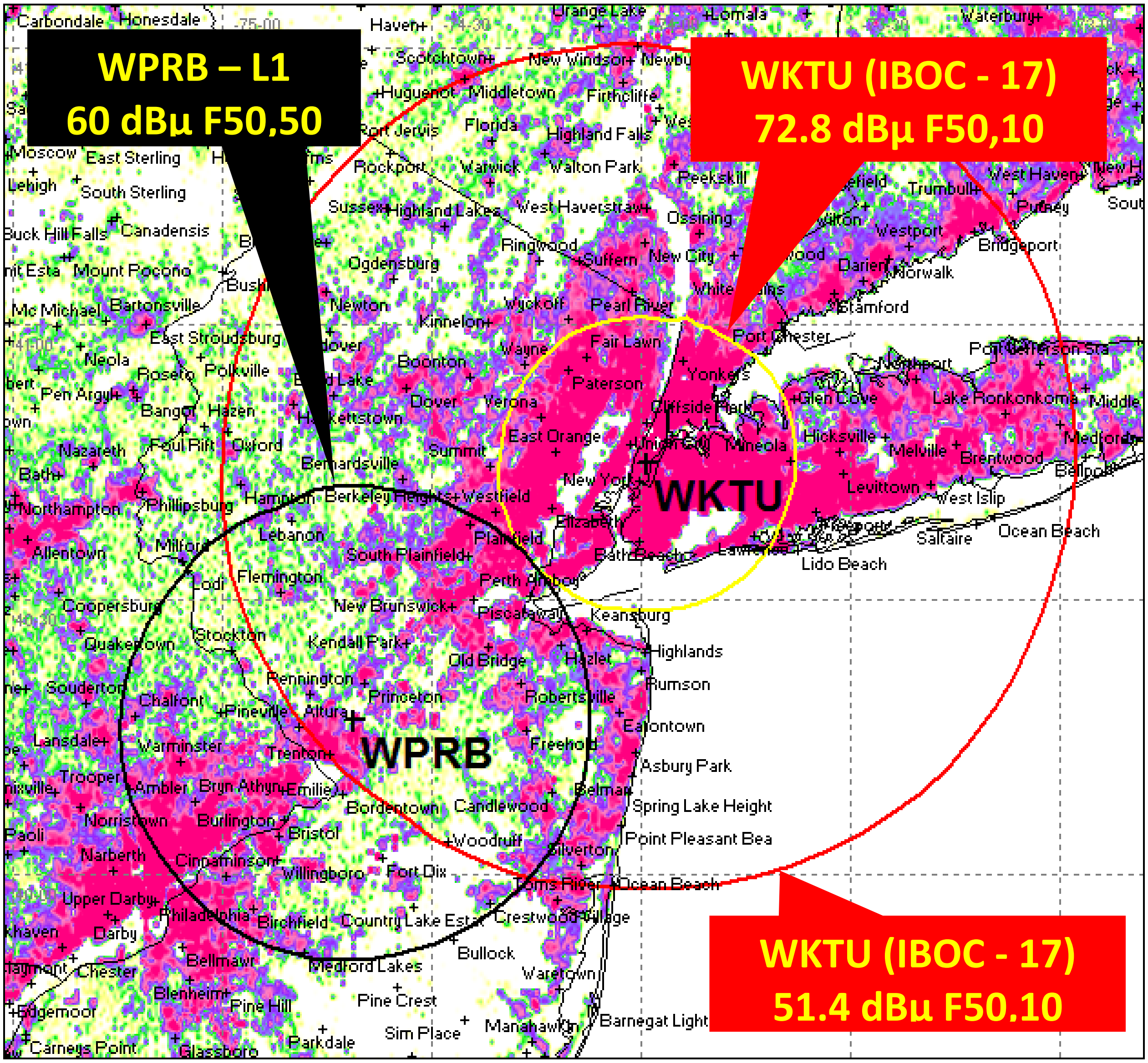


Figure 3. WKTU/WPRB interference contours

A similar situation is found with KFRG-FM, a Class B station in San Bernardino, California, and its first adjacent station, KBZT-FM in San Diego. Figure 4 shows KFRG's 63.7 dBμ F(50,10) interfering contour is tangential to KBZT's 60 dBμ F(50,50) contour. This is 12.3 dB above the 51.4 dBμ level that is dictated by the existing formula. The D/U ratio is -

3.7 dB, which is 12.3 dB worse than the 8.6 dB D/U ratio limit of the existing formula. Again, there have been no reports of interference from KFRG into KBZT.

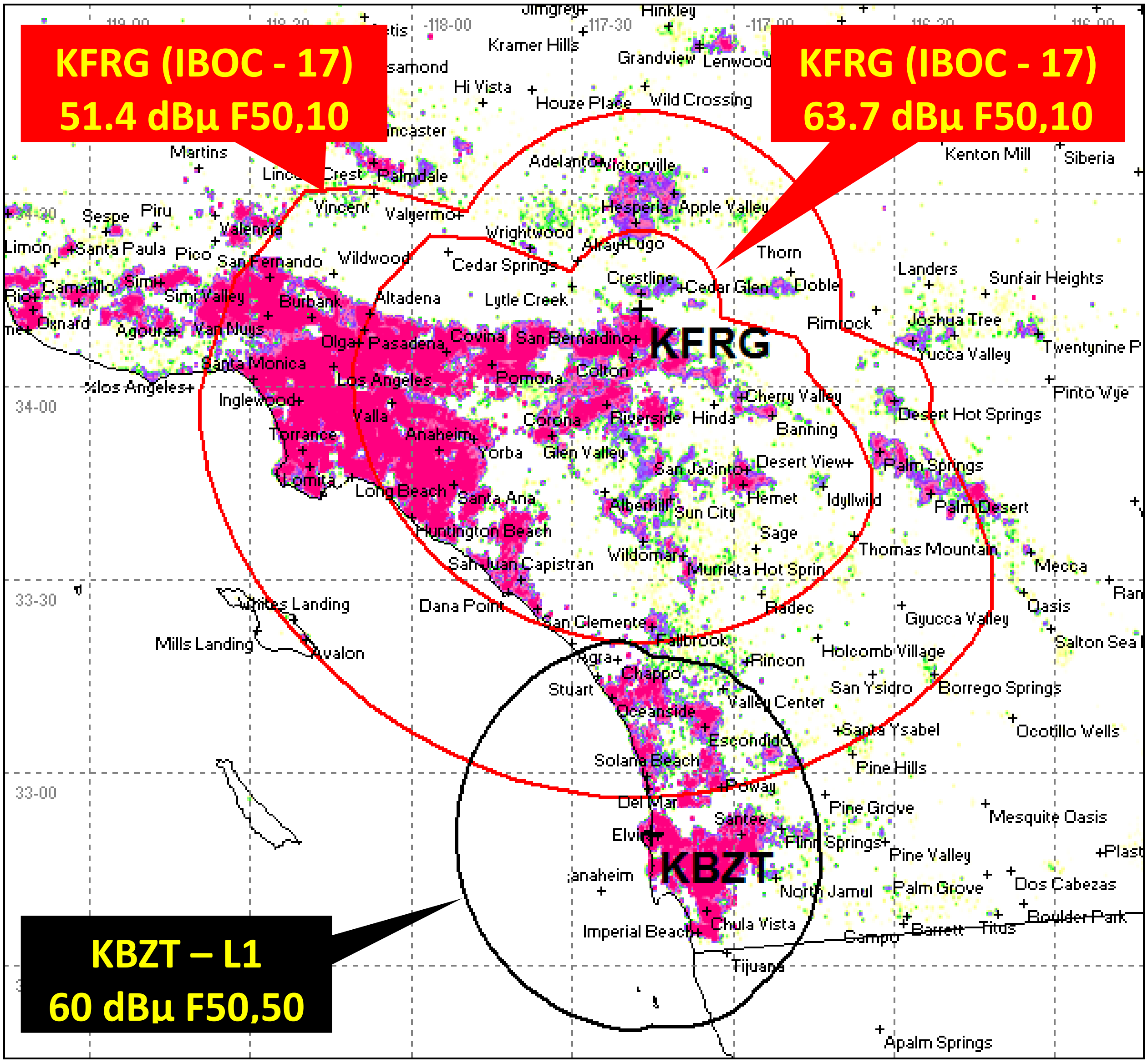


Figure 4. KFRG/KBZT interference contours

WJFK-FM, a Class B station in Manassas, Virginia provides another interesting example because it is short spaced to both its upper and lower first adjacent stations. As shown in Figure 5 below, WJFK's 71.5 dBμ F(50,10) interfering contour is tangential to its lower first adjacent WWMX's 60 dBμ F(50,50) contour, and its 75.6 dBμ F(50,10) interfering contour is tangential to its upper first adjacent WWEG's 60 dBμ F(50,50) contour. This is 20.1 dB and 24.2 dB, respectively, above the 51.4 dBμ level. The D/U ratios would be -11.5 dB for the lower first adjacent and -15.6 dB for the upper first adjacent – in both cases significantly worse that the 8.6 dB D/U limit under the existing formula. As was the case in New York and Los Angeles, there have been no reports of interference with these higher interference levels.

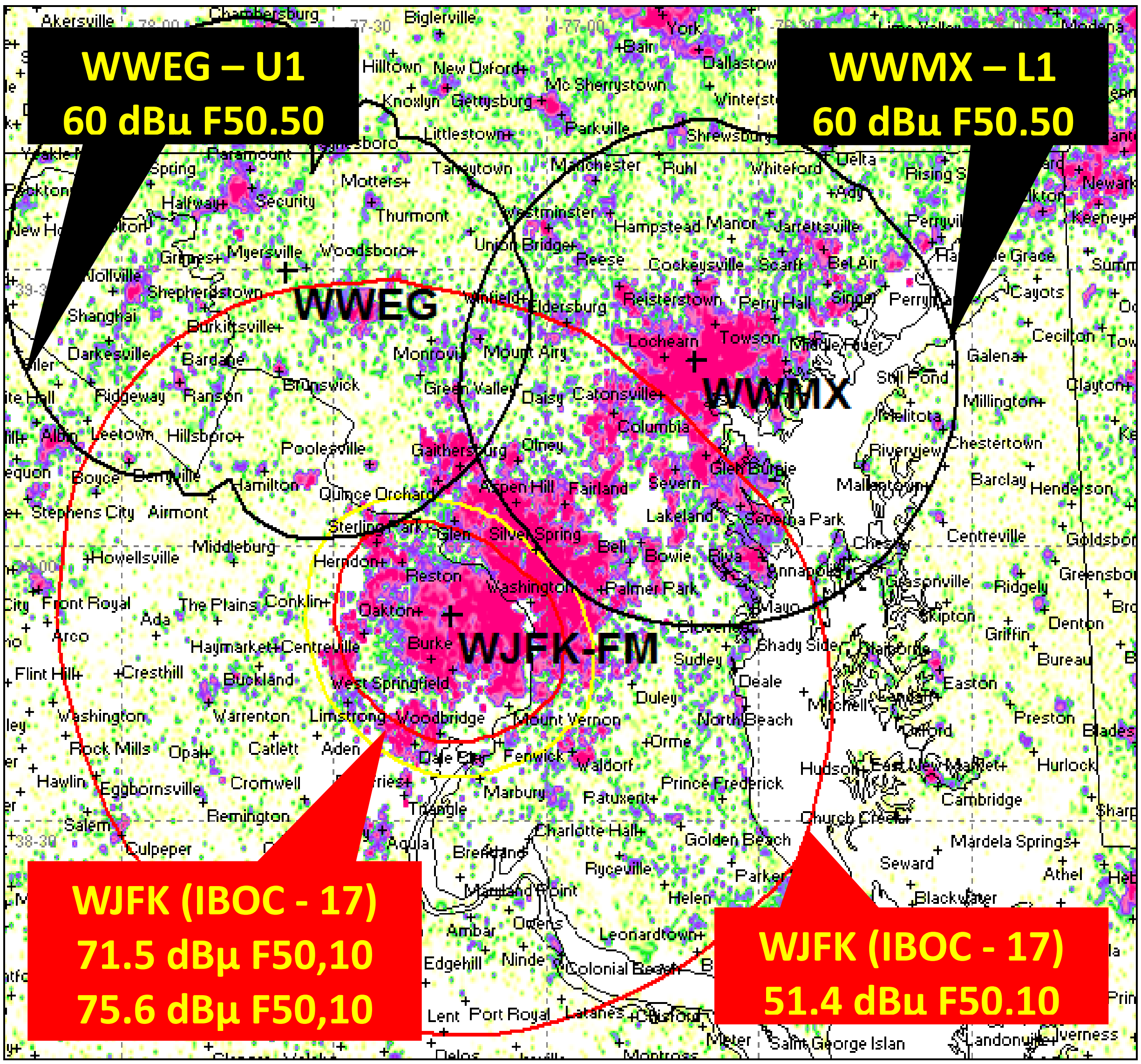


Figure 5. WJFK/WWMX/WWEG interference contours

A final example shown in Figure 6 is Class C WBAV-FM in Charlotte, North Carolina. WBAV's 58.9 dBμ F(50,10) interfering contour is tangential to WJMH's 60 dBμ F(50,50) contour. This is 7.5 dB above the 51.4 dBμ level that is dictated by the existing formula and would result in a 1 dB D/U ratio, which is 7.6 dB worse than the 8.6 dB limit under the existing formula. As with the previous examples, there have been no reports of interference.

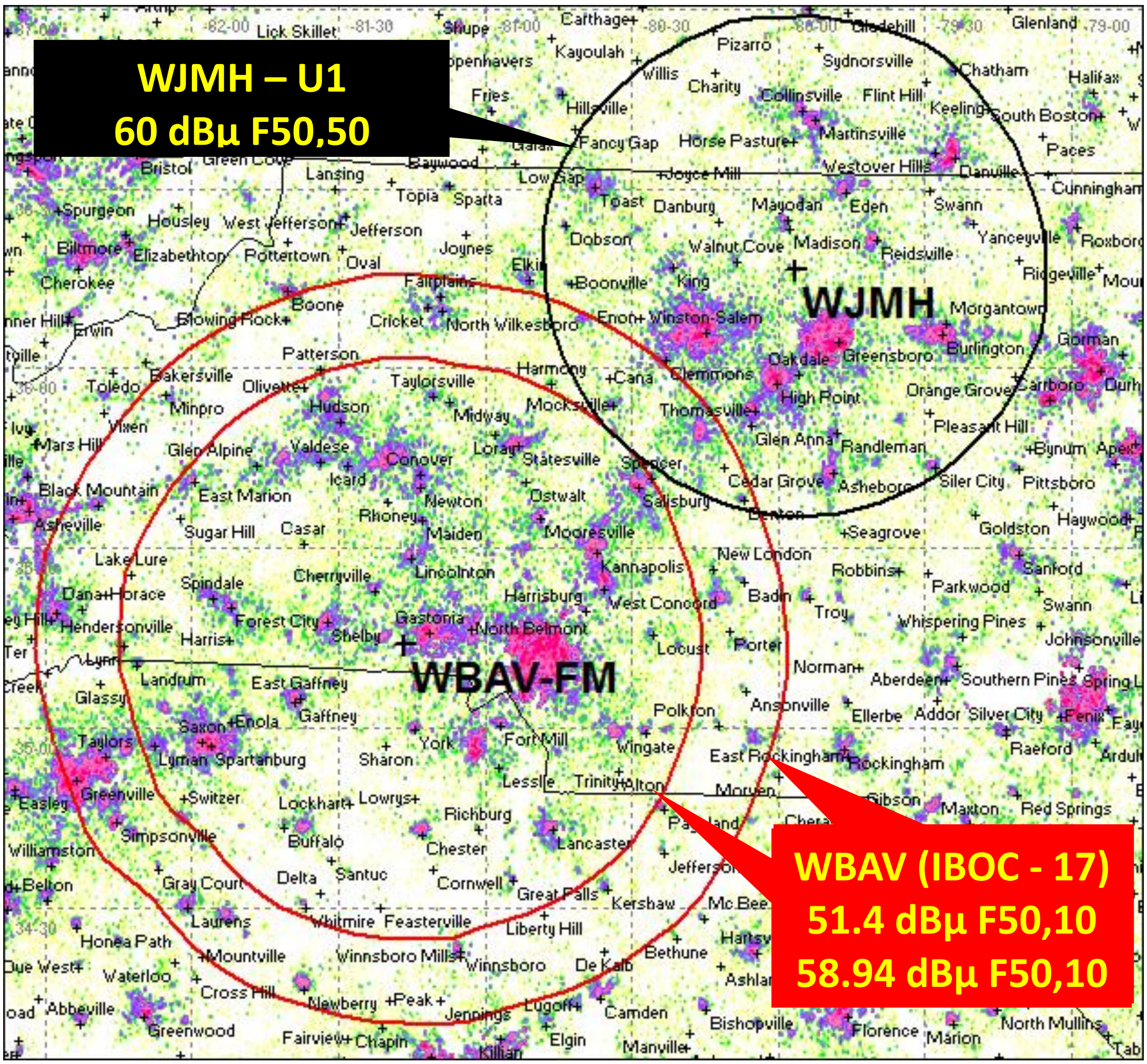


Figure 6. WBAV/WJMH interference contours

In order to develop a formula based on the interference levels that have been found to be acceptable in the field, the NAB/Xperi study considered a range of field strength levels in excess of those that would be permitted under the existing formula where harmful interference is not occurring even with ongoing digital operations.[21] The conclusion was that a better approach would be to allow all stations where the 54 dBμ F(50,10) contour of the digital station is tangential to the 60 dBμ F(50,50) contour of the analog station to increase digital power to -13 dBc sideband power or -10 dBc total power.[22] As shown in the table above, this represents on average about a 5.5 dB increase in the F(50,10) IBOC station power allowed at the desired station's F(50,50) 60 dBu contour compared to the current formula. Our proposal is a simplified formula that calculates allowable digital power (per sideband) by subtracting the digital station's F50,10 field intensity at the analog first adjacent station's 60 dBμ contour from a constant:

> Allowable IBOC power (dBc, per sideband) = 41 – [IBOC Station F(50,10) dBμ at the desired station 60 dBμ F(50,50) contour]

In the case of the New York/Philadelphia market overlap, which represents an extreme example of short spacing that restricts large market stations from increasing power, this new formula would allow a number of New York and Philadelphia stations to increase to -13 dBc per sideband power or -10 dBc total power. Based on the absence of interference with existing IBOC signal levels for short-spaced stations currently operating at -14 dBc, the Petitioners are confident that this new formula will allow some stations to increase power without causing harmful interference. This formula should be applied to all stations of all

[21] *See* Appendix 1.
[22] For properly spaced stations, this formula would be calculated as 41 – 54 = -13 dBc per sideband or 44 – 54 = -10 dBc total power.

classes, including Grandfathered Superpowered Stations. At the same time, the formula continues to constrain power in cases where there is a greater potential for harmful interference due to more extreme short spacing.[23] In the unlikely event that harmful interference does occur, the Commission's existing procedures for addressing digital interference would be able to appropriately address any problem.[24]

III. FIELD TESTING DEMONSTRATES NO NOTICABLE DEGRADATION OF THE DESIRED SIGNAL

Two separate field tests were conducted under FCC experimental authority, one on March 15, 2021 (Connecticut test, CT), and one on March 29, 2021 (New Jersey test, NJ), to determine whether allowing for high-power operation based upon the proposed formula could result in acceptable performance and not create objectionable interference. The location of each participating station and the test locations (denoted by a yellow cross) are shown in the map below and a technical description of these tests is provided in Appendix 2.[25]

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[23] As previously noted, none of the digital stations referenced in Figures 3 through 6 would be able to increase digital power on severely short-spaced sidebands even using the proposed new formula. The proposed new formula would continue to provide protections from short-spaced stations causing harmful interference.

[24] 2010 Order at 26-30.

[25] Appendix 2 is a letter from Audacy to FCC Audio Division, July 22, 2021. This letter included the engineering report required by the FCC at the completion of an experimental authorization.

Briefly, these tests involved operating a 1st-adjacent undesired IBOC station at both -14 and -10 dBc and recording the received audio on the desired analog FM signal. These audio recordings were then subjectively evaluated by a group of expert listeners to assess whether there was any difference in the desired signal audio quality for the -14 and -10 dBc interferer cases.[26]

For both tests, the desired station was WNYC 93.9 FM, a full-power, non-directional Class B station licensed to New York, NY and transmitting from the Empire State Building. WNYC, which is licensed to New York Public Radio (NYPR), is New York's flagship public radio station, airing programs from NPR, American Public Media, Public Radio Exchange and the

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[26] Using the FCC's FM and TV propagation curves (https://www.fcc.gov/media/radio/fm-and-tv-propagation-curves), the FCC(50,10) contours for the undesired IBOC stations were calculated to be 52.6 dBu (WZMX, CT test) and 52.7 dBu (WIP-FM, NJ test) at the WNYC F(50,50) 60 dBu contour. Consequently, both WZMX and WIP would be limited to -14 dBc under the current formula but would be able to increase to -10 dBc under the proposed formula.

BBC World Service, as well as a wide range of local programming. The format during weekdays is mostly spoken word, talk-based content.

The test routes were selected to be in populated areas just within the WNYC primary protected 54dBu contour. Each route was tested twice in the same day. First, measurements and recordings were made using the presently permitted (interfering) -14 dBc power levels and then shortly after, the exact route was driven again with the interfering power increased to the proposed, elevated -10 dBc power levels.

Representatives of Xperi, NYPR, and/or Audacy were present for all testing and, along with NAB, reviewed all of the test material, recordings and data. Further, the data collected was shared with the NAB Radio Technology Committee (NABRTC) for evaluation.[27] A presentation describing the details of the audio recording evaluation and the results obtained is included in Appendix 3. The conclusion of the test data was that there is no significant change or degradation of the desired WNYC signal when the 1st-adjacent channel interferer went from -14 dBc to -10 dBc, as summarized in this table (taken from Appendix 3).[28]

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[27] The NAB Radio Technology Committee (NABRTC) meets regularly to consider technical issues of importance to U.S. radio broadcasters. Its membership includes many highly respected and broadly experienced technologists in the radio industry. Frequently discussed subjects include digital radio broadcasting, AM and FM radio improvement, RDS and other broadcast metadata systems and emergency alerting. The NAB staff liaison is NAB Vice President, Advanced Engineering David Layer.

[28] Note that a p-value analysis of the small differences shown in the table confirms that they are statistically insignificant.

	Test team		NABRTC	
	CT	NJ	CT	NJ
RX1	-0.4	-0.3	0	-0.4
RX2	0	0	0.2	0
RX3	0	0.3	0.1	-0.5
RX4	0	-0.1	0	0

(Numbers are difference in subjective eval score)

(Subjective eval score ranges from 1=poor to 5=excellent)

Key:
- -10 sounds worse than -14
- -10 and -14 sound the same
- -14 sounds worse than -10

IV. CONCLUSION

For the reasons stated above, the Petitioners respectfully request that the Commission promptly grant this Petition for Rulemaking to allow FM stations compliant with the updated formula to increase FM digital power.

Respectfully submitted,

National Association of Broadcasters
1 M Street SE
Washington, DC 20003
(202) 429-5430

__/s/ Rick Kaplan /s/
Rick Kaplan
Larry Walke
Lynn Claudy
David Layer

Xperi Inc.
6711 Columbia Gateway Dr
Suite 500
Columbia, MD 21046

/s/ Mike Spillner /s/
Mike Spillner

Dated: October 26, 2022

APPENDIX 1

Allocation Evaluation for IBOC Power Increase

Presentation to the 2017 IEEE Broadcast Symposium, October 10-12, 2017, Arlington VA

Allocation Evaluation for IBOC Power Increase

Russ Mundschenk
Senior Manager, Broadcast Engineering
Xperi, Inc

Glynn Walden
Senior Vice-President, Broadcast Engineering
CBS Radio (Retired)

October 12, 2017

Executive Summary

In September 2007, and with the assistance of CBS, Clear Channel (now iHeart Media) and Greater Media (now Beasley), iBiquity Digital Corp released the results of a year long field test program conducted on 6 FM stations of various classes and geographic location. Entitled "Compatibility and Performance Tests at Elevated Digital Power" this test program reached the conclusion that the only way the Hybrid FM HD Radio™ system was to achieve coverage parity with it's analog host was to increase the digital power level by a full 10 dB, from -20 dBc to -10 dBc.

Seven years ago,, the FCC released a Docket authorizing IBOC stations to increase their total HD power by 6 dB to -14 dBc and up to a full -10 dBc for those stations meeting first adjacent channel protection requirements as set forth in the formula.

- **2.27 X (60 – F50,10 @ worst case first adjacent 60 dBu F50,50 contour) – 33.6**
  - Coerced to a minimum power of **-14** and a maximum of **-10 dB** below the analog power (dBc)
- **-14 dBc represents an interfering power of 51.3656 dBµ → 8.6344 dB D/U**

  (Vs 6 dB D/U, the FCC First Adjacent Spacing Spec)
- **-10 dBc represents an interfering power of 49.6305 dBµ → 10.36954 dB D/U**

Due to the 2.27 multiplication factor, a **4 dB IBOC Power** differential corresponds to a **1.7621 dB F50,10** interfering level differential. The 2.27 "factor" appears to be a curve-fit to account for receiver performance at the point of receiver stereo-mono blend and/or audio bandwidth reduction.

Power Measurement

<u>Note:</u> Throughout this presentation there will be references to ***TOTAL POWER*** and ***SIDEBAND POWER.***

Total Power refers to the total integrated power of both primary sidebands.

- 2.27 X (60 – F50,10 @ worst case first adjacent 60 dBu F50,50 contour) – ***<u>33.6</u>***

Sideband Power is ***<u>3 dB</u>*** less than symmetrical ***Total Power*** and refers to the power of a single lower or upper primary partition.

- 2.27 X (60 – F50,10 @ worst case first adjacent 60 dBu F50,50 contour) – ***<u>36.6</u>***

Technology improvements since the rule adoption allows independent adjustment of each IBOC sideband's power level - tailored to a station's first-adjacent allocations.

First Adjacent Study

In 2017, Xperi and NAB contracted with Cavell-Mertz & Associates to convert their 1st-adjacent contour calculator into a sortable spreadsheet. This 10,000 row spreadsheet provides information on every protected FM station in the US and their three worst 1st-adjacent neighbors. Additional columns (and macros) were added by Xperi to augment and refine the data.

HD Radio Power Increase Candidacy - All USA Stations

Enter "K" Factor Below

Power Formula -->

Count of Stations Meeting IBOC Power Criteria By FCC Power Increase Formula and Proposed New Power Increase Formula

Sideband Power above Maximum Allowed by Formula (dB) -->	FCC Power Increase Formula: Power (dBc/SB) = (2.27 * (60 -IBOC F50,10 @ Victim 60 dBu F50,50)) - 36.6											Proposed Power Formula: Power (dBc/SB) = Power (dBc/SB) = "K" - (IBOC F50,10 @ Victim 60 dBu F50,50)										
	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10 - 12	12 - 14	14 - 16	16 - 18	18 - 20	> 20	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10	10 - 12	12 - 14	14 - 16	16 - 18	18 - 20	> 20
All USA FM Stations (IBOC & Non-IBOC) (Exceeding formula Maximums by "X" dB)																						
Lower Sideband Power (# of dB >-17 dBc)	520.0	536.0	679.0	144.0	63.0	44.0	29.0	33.0	28.0	17.0	69.0	55.0	24.0	14.0	12.0	6.0	3.0	4.0	5.0	0.0	0.0	5.0
Total Power (# of dB >-14 dBc)	742.0	283.0	274.0	48.0	22.0	13.0	5.0	6.0	5.0	7.0	8.0	45.0	6.0	1.0	1.0	3.0	1.0	1.0	0.0	0.0	0.0	0.0
Upper Sideband Power (# of dB >-17 dBc)	54.0	32.0	24.0	12.0	5.0	6.0	5.0	9.0	10.0	6.0	31.0	48.0	25.0	9.0	11.0	7.0	7.0	3.0	3.0	1.0	0.0	6.0
Currently Operating USA FM IBOC Stations Only (Exceeding formula Maximums by "X" dB)																						
Lower Sideband Power (# of dB >-17 dBc)	62.0	32.0	33.0	21.0	12.0	8.0	10.0	4.0	5.0	1.0	30.0	9.0	6.0	2.0	2.0	4.0	1.0	1.0	2.0	0.0	0.0	2.0
Total Power (# of dB >-14 dBc)	24.0	24.0	12.0	6.0	4.0	4.0	5.0	1.0	3.0	1.0	6.0	4.0	1.0	0.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	1.0
Upper Sideband Power (# of dB >-17 dBc)	54.0	32.0	24.0	12.0	5.0	6.0	4.0	8.0	10.0	5.0	31.0	10.0	6.0	5.0	3.0	4.0	0.0	0.0	0.0	1.0	0.0	2.0
High: @ -13 dBc/SB or -10 dBc/Total	7530.0	7499.0			5783.0			7559.0	7531.0			10115.0	10057.0			9717.0			10116.0	10062.0		
Mid: -17 to -13 dBc/SB or -14 to -10 dBc/Total	853.0	868.0	See Above		4007.0	See Above		892.0	904.0	See Above		302.0	305.0	See Above		744.0	See Above		303.0	303.0	See Above	
Low: @ -17 dBc/SB or -14 dBc/Total	2167.0	2183.0			758.0			2097.0	2040.0			133.0	188.0			87.0			129.0	110.0		

FCC Power Increase Formula: Power (dBc/SB) = 2.27 * (60 - F50,10*) - 36.6

Proposed Pwr Increase Formula: Power (dBc/SB) = "K" - F50,10*

F50,10* = IBOC station's field intensity in dBu at the victim's 60 dBu F50,50

FCC Power Formula: Power (dBc/SB) = 2.27 * (60 - F50,10*) - 36.6

Rank	Call	HD? HD & Super-B?	Super B Max Pwr	Current HD Pwr LSB	Current HD Pwr Total	Current HD Pwr USB	Capable HD Pwr LSB	Capable HD Pwr USB	Lower F50,10 @ Victim 60 dBu F50,50	LSB dBu F50,10 None = -1000		Total USB + LSB Ifc	Upper F50,10 @ Victim 60 dBu F50,50	USB dBu F50,10 None = -1000	
5	WJFK	HD		-17.0	-20.0	-17.0			WJFK-L1/WWMX=70.0576465143796	70.06	18.7	76.01	WJFK-U1/WWEG=74.7417539172906	74.74	23.4
7	WPRB	HD		-23	-20.0	-23			WPRB-L1/WBZO=41.9549760755236	41.95	-15.4	73.87	WPRB-U1/WKTU=73.8696668869602	73.87	16.5
9	WMAG	HD		-23	-20.0	-23			WMAG-L1/WZAX=49.3213371222854	49.32	-8.0	73.48	WMAG-U1/WRFX=73.461545332467	73.46	16.1
4	KRTH	HDSB	-23.0	-23	-20.0	-23	-23.0	-23.0	KRTH-L1/KAEH=73.5663658653281	73.57	16.2	76.20	KRTH-U1/KATY-FM=72.766701784709	72.77	15.4
15	WUSL	HD		-23	-20.0	-23			WUSL-L1/WEPN-FM=51.9743702046311	51.97	-5.4	71.24	WUSL-U1/WAWZ=71.1839884171047	71.18	13.8
18	WZPL	HD		-23	-20.0	-23			WZPL-L1/WCJC=52.4841563148868	52.48	-4.9	70.86	WZPL-U1/WSHW=70.7929790638078	70.79	13.4
25	KCRW	HD		-23	-20.0	-23			KCRW-L1/KSGN=58.1596063212587	58.16	0.8	69.31	KCRW-U1/KBPK=68.960533293308	68.96	11.6
26	WWMX	HD		-23.0	-20.0	-23.0	-17.0	-17.0	WWMX-L1/WCEM-FM=57.0621737490302	57.06	-0.3	69.21	WWMX-U1/WJFK-FM=68.9399300705089	68.94	11.6
32	WZAK	HD		-23	-20.0	-23			WZAK-L1/WLTJ=46.6222700032724	46.62	-10.7	68.22	WZAK-U1/WNCD=68.1908488862205	68.19	10.8
34	WKKT	HD		-23	-20.0	-23			WKKT-L1/WLTY=51.3720427672759	51.37	-6.0	68.13	WKKT-U1/WQMG=68.0348889437615	68.03	10.7
36	WRCJ	HD		-23	-20.0	-23			WRCJ-L1/WNFR=52.2431407217468	52.24	-5.1	67.63	WRCJ-U1/WFUM=67.5038505899222	67.50	10.1
8	WKTU	HD		-17	-14.0	-17			WKTU-L1/WPRB=72.8223015038247	72.82	21.5	73.82	WKTU-U1/WNNJ=66.9326818495503	66.93	15.6
39	WPRS	HD		-23	-20.0	-23			WPRS-L1/WTLP=52.4100589661784	52.41	-5.0	66.69	WPRS-U1/WZFT=66.5295715964289	66.53	9.2
38	KLOS	HDSB	-22.9	-23	-20.0	-23			KLOS-L1/KLLY=56.8767240918395	56.88	-0.5	66.74	KLOS-U1/KSSX=66.2638354814785	66.26	8.9
41	WPZR	HD		-23	-20.0	-23			WPZR-L1/WIOG=58.8991502597799	58.90	1.5	66.44	WPZR-U1/WWWW-FM=65.5996741379558	65.60	8.2
24	KTWV	HDSB	-22.6	-23	-20.0	-23			KTWV-L1/KMYT=67.6152097847694	67.62	10.3	69.55	KTWV-U1/KBZT=65.0937997008689	65.09	7.7
60	KOIT	HDSB	-20.8	-23	-20.0	-23			KOIT-L1/KUBB=40.0754447320247	40.08	-17.3	64.90	KOIT-U1/KNOB=64.8810214852345	64.88	7.5
62	WMXD	HD		-23	-20.0	-23			WMXD-L1/WOHF=45.1316396019928	45.13	-12.2	64.65	WMXD-U1/WVKS=64.604947921542	64.60	7.2
53	WKCI	HD		-17	-14.0	-17			WKCI-L1/WCBS-FM=57.2614842108472	57.26	5.9	65.32	WKCI-U1/WPDH=64.5802159276235	64.58	13.2
66	WJLK	HD		-23	-20.0	-23			WJLK-L1/WIP-FM=48.5032578036353	48.50	-8.9	64.51	WJLK-U1/WPST=64.3981931462644	64.40	7.0
68	WPEG	HD		-23.0	-20.0	-23.0	-20.0	-20.0	WPEG-L1/WRIC-FM=37.6986150344121	37.70	-19.7	64.28	WPEG-U1/WBRF=64.2718933763284	64.27	6.9
71	WDAC	HD		-23	-20.0	-23			WDAC-L1/WQCM=44.2547043068016	44.25	-13.1	63.97	WDAC-U1/WDSD=63.9260340285099	63.93	6.6
54	WTSS	HDSB	-23.0	-23	-20.0	-23			WTSS-L1/WVOR=59.8694809031394	59.87	2.5	65.22	WTSS-U1/WLGZ-FM=63.728740170307	63.73	6.4
50	KOST	HDSB	-23.4	-23	-20.0	-23			KOST-L1/KTMQ=61.4751651739456	61.48	4.1	65.61	KOST-U1/KMLA=63.4871378774328	63.49	6.1
77	WRCH	HD		-23	-20.0	-23			WRCH-L1/WHTZ=48.4603243042083	48.46	-8.9	63.39	WRCH-U1/WHUD=63.2501287476551	63.25	5.9
73	WEBN	HD		-23	-20.0	-23			WEBN-L1/WMDH-FM=52.8883096348321	52.89	-4.5	63.57	WEBN-U1/WDHT=63.1797137217774	63.18	5.8
78	KXFG	HD		-17.0	-14.0	-17.0			KXFG-L1/KYLA=53.5248874070043	53.52	2.2	63.39	KXFG-U1/KCBS-FM=62.9189411366527	62.92	11.6
92	WPAW	HD		-23	-20.0	-23			WPAW-L1/WEGX=47.9534583411935	47.95	-9.4	62.67	WPAW-U1/WOGR-FM=62.5237174720015	62.52	5.2
94	WVKL	HDSB	-17.1	-23	-20.0	-23			WVKL-L1/WPWZ=49.0248693088934	49.02	-8.3	62.64	WVKL-U1/WPNC-FM=62.4496851875389	62.45	5.1
109	KIIS	HDSB	-22.7	-23	-20.0	-23			KIIS-L1/KCNQ=36.8016668053888	36.80	-20.6	62.05	KIIS-U1/KXLM=62.0349536744213	62.03	4.7
27	WQMG	HD		-23	-20.0	-23			WQMG-L1/WKKT=67.9009425114767	67.90	10.5	68.89	WQMG-U1/WKBC-FM=61.9623259257432	61.96	4.6
108	WPHI	HD		-23	-20.0	-23			WPHI-L1/WMGM=49.1304314276911	49.13	-8.2	62.05	WPHI-U1/WAEB-FM=61.8268074555098	61.83	4.5
83	KOHT	HD		-23	-20.0	-23			KOHT-L1/KTBX=57.3249965365527	57.32	0.0	63.06	KOHT-U1/KRDX=61.7154907573443	61.72	4.4
101	WWWT	HD		-21	-18.0	-21			WWWT-L1/WCHV-FM=54.4664268367237	54.47	-0.9	62.42	WWWT-U1/WLZL=61.6636404414552	61.66	6.3
114	KFRC	HDSB	-18.2	-23	-20.0	-23			KFRC-L1/KPQS=47.2770027943641	47.28	-10.1	61.81	KFRC-U1/KSRT=61.6544546025695	61.65	4.3
28	KCBS	HDSB	-23.2	-23	-20.0	-23			KCBS-L1/KXFG=67.8233475007094	67.82	10.5	68.75	KCBS-U1/KBHR=61.5972957751427	61.60	4.2
85	KSOL	HD		-23	-20.0	-23			KSOL-L1/KXTS=57.2399934142728	57.24	-0.1	62.93	KSOL-U1/KSQL=61.5707087572702	61.57	4.2
104	WERS	HD		-23	-20.0	-23			WERS-L1/WJMF=52.5475708364201	52.55	-4.8	62.08	WERS-U1/WHAB=61.5706979688551	61.57	4.2
95	KIOI	HDSB	-23.0	-17	-14.0	-17			KIOI-L1/KHYL=56.2721561578113	56.27	4.9	62.64	KIOI-U1/KCCL=61.5038991657539	61.50	10.1
122	WBTN	HD		-23	-20.0	-23			WBTN-L1/WNYV=45.8626516286078	45.86	-11.5	61.60	WBTN-U1/WYKV=61.487338878947	61.49	4.1
81	WBLI	HD		-19	-16.0	-19			WBLI-L1/WHCN=59.0769885422203	59.08	5.7	63.28	WBLI-U1/WFME-FM=61.2017914998499	61.20	7.8

Power by FCC Formula

Rank	Call	LSB Power	Coerced LSB Power	Ifc Above Max LSB	Ifc Above Act LSB	Coerced LSB+USB Power	Ifc Above Max Tot	Ifc Above Act Tot	USB Power	Coerced USB Power	Ifc Above Max USB	Ifc Above Act USB
5	WJFK	-59.43	-17.0	42.4	42.4	-14.0	45.1	39.1	-70.06	-17.0	53.1	53.1
7	WPRB	4.36	-13.0	-17.4	-27.4	-11.5	-15.9	-24.4	-68.08	-17.0	51.1	45.1
9	WMAG	-12.36	-13.0	-0.6	-10.6	-11.5	0.8	-7.6	-67.16	-17.0	50.2	44.2
4	KRTH	-67.40	-23.0	44.4	44.4	-20.0	43.4	43.4	-65.58	-23.0	42.6	42.6
15	WUSL	-18.38	-17.0	1.4	-4.6	-14.0	4.4	-1.6	-61.99	-17.0	45.0	39.0
18	WZPL	-19.54	-17.0	2.5	-3.5	-14.0	5.5	-0.5	-61.10	-17.0	44.1	38.1
25	KCRW	-32.42	-17.0	15.4	9.4	-14.0	18.4	12.4	-56.94	-17.0	39.9	33.9
26	WWMX	-29.93	-17.0	12.9	6.9	-14.0	15.9	9.9	-56.89	-17.0	39.9	33.9
32	WZAK	-6.23	-13.0	-6.8	-16.8	-11.5	-5.3	-13.8	-55.19	-17.0	38.2	32.2
34	WKKT	-17.01	-17.0	0.0	-6.0	-14.0	3.0	-3.0	-54.84	-17.0	37.8	31.8
36	WRCJ	-18.99	-17.0	2.0	-4.0	-14.0	5.0	-1.0	-53.63	-17.0	36.6	30.6
8	WKTU	-65.71	-17.0	48.7	48.7	-14.0	38.2	38.2	-52.34	-17.0	35.3	35.3
39	WPRS	-19.37	-17.0	2.4	-3.6	-14.0	5.4	-0.6	-51.42	-17.0	34.4	28.4
38	KLOS	-29.51	-22.9	6.7	6.5	-19.8	9.6	9.5	-50.82	-22.9	28.0	27.8
41	WPZR	-34.10	-17.0	17.1	11.1	-14.0	20.0	14.0	-49.31	-17.0	32.3	26.3
24	KTWV	-53.89	-22.6	31.3	30.9	-19.6	27.5	27.1	-48.16	-22.6	25.6	25.2
60	KOIT	8.63	-20.8	-29.4	-31.6	-17.8	-26.4	-28.6	-47.68	-20.8	26.9	24.7
62	WMXD	-2.85	-13.0	-10.2	-20.2	-11.5	-8.7	-17.1	-47.05	-17.0	30.1	24.1
53	WKCI	-30.38	-17.0	13.4	13.4	-14.0	16.3	16.3	-47.00	-17.0	30.0	30.0
66	WJLK	-10.50	-13.0	-2.5	-12.5	-11.5	-1.0	-9.5	-46.58	-17.0	29.6	23.6
68	WPEG	14.02	-13.0	-27.0	-37.0	-11.5	-25.6	-34.0	-46.30	-17.0	29.3	23.3
71	WDAC	-0.86	-13.0	-12.1	-22.1	-11.5	-10.7	-19.1	-45.51	-17.0	28.5	22.5
54	WTSS	-36.30	-23.0	13.3	13.3	-20.0	15.8	15.8	-45.06	-23.0	22.1	22.1
50	KOST	-39.95	-23.4	16.6	16.9	-20.4	18.3	18.7	-44.52	-23.4	21.2	21.5
77	WRCH	-10.40	-13.0	-2.6	-12.6	-11.5	-1.1	-9.6	-43.98	-17.0	27.0	21.0
73	WEBN	-20.46	-17.0	3.5	-2.5	-14.0	6.4	0.4	-43.82	-17.0	26.8	20.8
78	KXFG	-21.90	-17.0	4.9	4.9	-14.0	7.9	7.9	-43.23	-17.0	26.2	26.2
92	WPAW	-9.25	-13.0	-3.7	-13.7	-11.5	-2.3	-10.7	-42.33	-17.0	25.3	19.3
94	WVKL	-11.69	-17.1	-5.4	-11.3	-14.1	-2.4	-8.3	-42.16	-17.1	25.0	19.2
109	KIIS	16.06	-22.7	-38.8	-39.1	-19.7	-35.8	-36.0	-41.22	-22.7	18.5	18.2
27	WQMG	-54.54	-17.0	37.5	31.5	-14.0	26.9	20.9	-41.05	-17.0	24.1	18.1
108	WPHI	-11.93	-13.0	-1.1	-11.1	-11.5	0.4	-8.1	-40.75	-17.0	23.7	17.7
83	KOHT	-30.53	-17.0	13.5	7.5	-14.0	16.1	10.1	-40.49	-17.0	23.5	17.5
101	WWWT	-24.04	-17.0	7.0	3.0	-14.0	9.9	5.9	-40.38	-17.0	23.4	19.4
114	KFRC	-7.72	-18.2	-10.5	-15.3	-15.2	-7.5	-12.3	-40.36	-18.2	22.1	17.4
28	KCBS	-54.36	-23.2	31.2	31.4	-20.1	19.9	20.1	-40.23	-23.2	17.1	17.2
85	KSOL	-30.33	-17.0	13.3	7.3	-14.0	15.9	9.9	-40.17	-17.0	23.2	17.2
104	WERS	-19.68	-17.0	2.7	-3.3	-14.0	5.7	-0.3	-40.17	-17.0	23.2	17.2
95	KIOI	-28.14	-23.0	5.1	11.1	-20.0	7.9	13.9	-40.01	-23.0	17.0	23.0
122	WBTN	-4.51	-13.0	-8.5	-18.5	-11.5	-7.0	-15.5	-39.98	-17.0	23.0	17.0
81	WBLI	-34.50	-17.0	17.5	15.5	-14.0	19.3	17.3	-39.33	-17.0	22.3	20.3

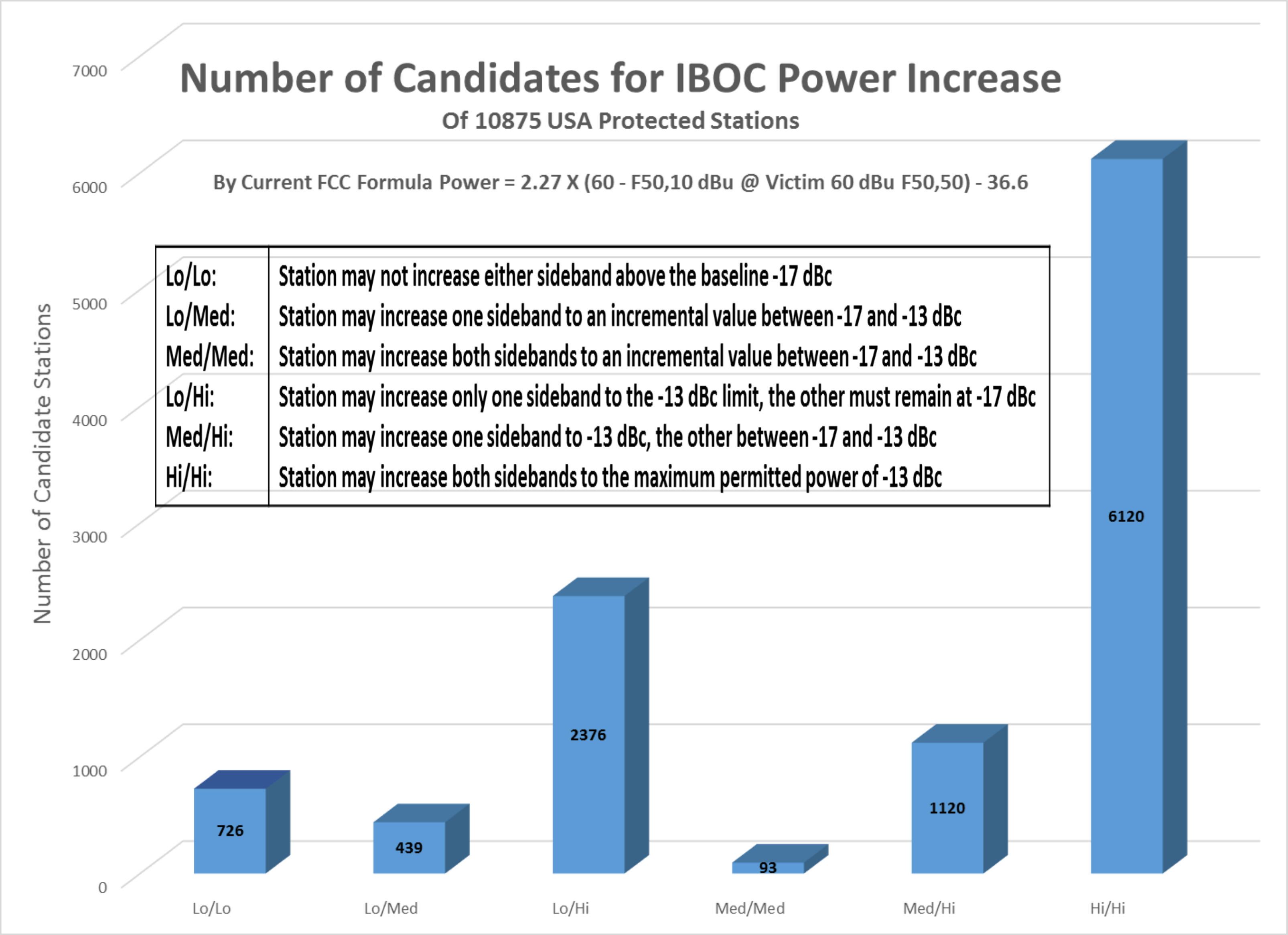
Proposed Power Formula K = 41.00

Rank	Call	LSB Power	Coerced LSB Power	Ifc Above Max LSB	Ifc Above Act LSB	Coerced LSB+USB Power	Ifc Above Max Tot	Ifc Above Act Tot	USB Power	Coerced USB Power	Ifc Above Max USB	Ifc Above Act USB
5	WJFK	-29.06	-17.0	12.1	12.1	-14.0	13.8	7.8	-33.74	-17.0	16.7	16.7
7	WPRB	-0.95	-13.0	-12.0	-22.0	-11.5	-10.6	-19.0	-32.87	-17.0	15.9	9.9
9	WMAG	-8.32	-13.0	-4.7	-14.7	-11.5	-3.2	-11.7	-32.46	-17.0	15.5	9.5
4	KRTH	-32.57	-23.0	9.6	9.6	-20.0	9.1	9.1	-31.77	-23.0	8.8	8.8
15	WUSL	-10.97	-13.0	-2.0	-12.0	-11.5	-0.6	-9.1	-30.18	-17.0	13.2	7.2
18	WZPL	-11.48	-13.0	-1.5	-11.5	-11.5	-0.1	-8.6	-29.79	-17.0	12.8	6.8
25	KCRW	-17.16	-17.0	0.2	-5.8	-14.0	2.8	-3.2	-27.96	-17.0	11.0	5.0
26	WWMX	-16.06	-16.1	0.0	-6.9	-13.5	2.3	-4.2	-27.94	-17.0	10.9	4.9
32	WZAK	-5.62	-13.0	-7.4	-17.4	-11.5	-6.0	-14.4	-27.19	-17.0	10.2	4.2
34	WKKT	-10.37	-13.0	-2.6	-12.6	-11.5	-1.3	-9.7	-27.03	-17.0	10.0	4.0
36	WRCJ	-11.24	-13.0	-1.8	-11.8	-11.5	-0.4	-8.9	-26.50	-17.0	9.5	3.5
8	WKTU	-31.82	-17.0	14.8	14.8	-14.0	10.9	10.9	-25.93	-17.0	8.9	8.9
39	WPRS	-11.41	-13.0	-1.6	-11.6	-11.5	-0.3	-8.7	-25.53	-17.0	8.5	2.5
38	KLOS	-15.88	-22.9	-7.0	-7.1	-19.8	-4.4	-4.6	-25.26	-22.9	2.4	2.3
41	WPZR	-17.90	-17.0	0.9	-5.1	-14.0	3.1	-2.9	-24.60	-17.0	7.6	1.6
24	KTWV	-26.62	-22.6	4.0	3.6	-19.6	2.6	2.2	-24.09	-22.6	1.5	1.1
60	KOIT	0.92	-20.8	-21.7	-23.9	-17.8	-18.7	-20.9	-23.88	-20.8	3.1	0.9
62	WMXD	-4.13	-13.0	-8.9	-18.9	-11.5	-7.5	-15.9	-23.60	-17.0	6.6	0.6
53	WKCI	-16.26	-16.3	0.0	-0.7	-13.6	1.9	1.5	-23.58	-17.0	6.6	6.6
66	WJLK	-7.50	-13.0	-5.5	-15.5	-11.5	-4.2	-12.6	-23.40	-17.0	6.4	0.4
68	WPEG	3.30	-13.0	-16.3	-26.3	-11.5	-14.9	-23.3	-23.27	-17.0	6.3	0.3
71	WDAC	-3.25	-13.0	-9.7	-19.7	-11.5	-8.3	-16.8	-22.93	-17.0	5.9	-0.1
54	WTSS	-18.87	-23.0	-4.1	-4.1	-20.0	-2.6	-2.6	-22.73	-23.0	-0.3	-0.3
50	KOST	-20.48	-23.4	-2.9	-2.5	-20.4	-2.0	-1.6	-22.49	-23.4	-0.9	-0.5
77	WRCH	-7.46	-13.0	-5.5	-15.5	-11.5	-4.2	-12.7	-22.25	-17.0	5.3	-0.7
73	WEBN	-11.89	-13.0	-1.1	-11.1	-11.5	0.0	-8.5	-22.18	-17.0	5.2	-0.8
78	KXFG	-12.52	-13.0	-0.5	-4.5	-11.5	0.5	-1.9	-21.92	-17.0	4.9	4.9
92	WPAW	-6.95	-13.0	-6.0	-16.0	-11.5	-4.7	-13.2	-21.52	-17.0	4.5	-1.5
94	WVKL	-8.02	-17.1	-9.1	-15.0	-14.1	-6.3	-12.2	-21.45	-17.1	4.3	-1.6
109	KIIS	4.20	-22.7	-26.9	-27.2	-19.7	-23.9	-24.2	-21.03	-22.7	-1.7	-2.0
27	WQMG	-26.90	-17.0	9.9	3.9	-14.0	6.0	0.0	-20.96	-17.0	4.0	-2.0
108	WPHI	-8.13	-13.0	-4.9	-14.9	-11.5	-3.6	-12.1	-20.83	-17.0	3.8	-2.2
83	KOHT	-16.32	-16.3	0.0	-6.7	-13.6	1.3	-5.0	-20.72	-17.0	3.7	-2.3
101	WWWT	-13.47	-13.5	0.0	-7.5	-11.9	0.8	-5.3	-20.66	-17.0	3.7	-0.3
114	KFRC	-6.28	-18.2	-12.0	-16.7	-15.2	-9.1	-13.9	-20.65	-18.2	2.4	-2.3
28	KCBS	-26.82	-23.2	3.7	3.8	-20.1	-0.5	-0.3	-20.60	-23.2	-2.6	-2.4
85	KSOL	-16.24	-16.2	0.0	-6.8	-13.6	1.3	-5.1	-20.57	-17.0	3.6	-2.4
104	WERS	-11.55	-13.0	-1.5	-11.5	-11.5	-0.5	-9.0	-20.57	-17.0	3.6	-2.4
95	KIOI	-15.27	-23.0	-7.7	-1.7	-20.0	-5.9	0.1	-20.50	-23.0	-2.5	3.5
122	WBTN	-4.86	-13.0	-8.1	-18.1	-11.5	-6.8	-15.2	-20.49	-17.0	3.5	-2.5
81	WBLI	-18.08	-17.0	1.1	-0.9	-14.0	2.0	0.0	-20.20	-17.0	3.2	1.2

Station Candidacy for Power Increase Under Current Formula

Under the current formula only 60 percent of stations qualify to operate at -10 dBc.

The other categories represent intermediate sideband power levels



Many Short Spaced IBOC Stations are Exceeding Current Limits

In summary:

- 60 percent of all stations are able to increase to a full -10 dBc
- About 33 percent can operate at an interim level.
- 7 percent of stations are so short-spaced to a first adjacent neighbor, that they can't increase their power at all.
- 335 short-spaced, operational HD stations, already exceed their authorized interference levels.
- # of HD Stations > 51.3656 dBu (Lower Sideband Only) 143
- # of HD Stations > 51.3656 dBu (Upper Sideband Only) 121
- # of HD Stations > 51.3656 dBu (Lower & Upper SB) +71
- **Total Stations Operating with HD Radio Technology 335 (Above Limit Due to Short Spacing)**

57 stations are exceeding their limits by 20 dB or more!

- Lower Sideband Only > 20 dB (Effective IBOC Power > +3 dBc) 26
- Upper Sideband Only > 20 dB (Effective IBOC Power > +3 dBc) 27
- Lower & Upper SB > 20 dB (Effective IBOC Power > +3 dBc) +4
- **Total Stations Operating with HD Radio Technology 58**
  (> 20 dB Above 51.36 Limit Due to Short Spacing)

The worst case short-spaced offenders create interference as though the are running an "effective" IBOC power level of *OVER +27 dBc* (for the appropriate sideband)

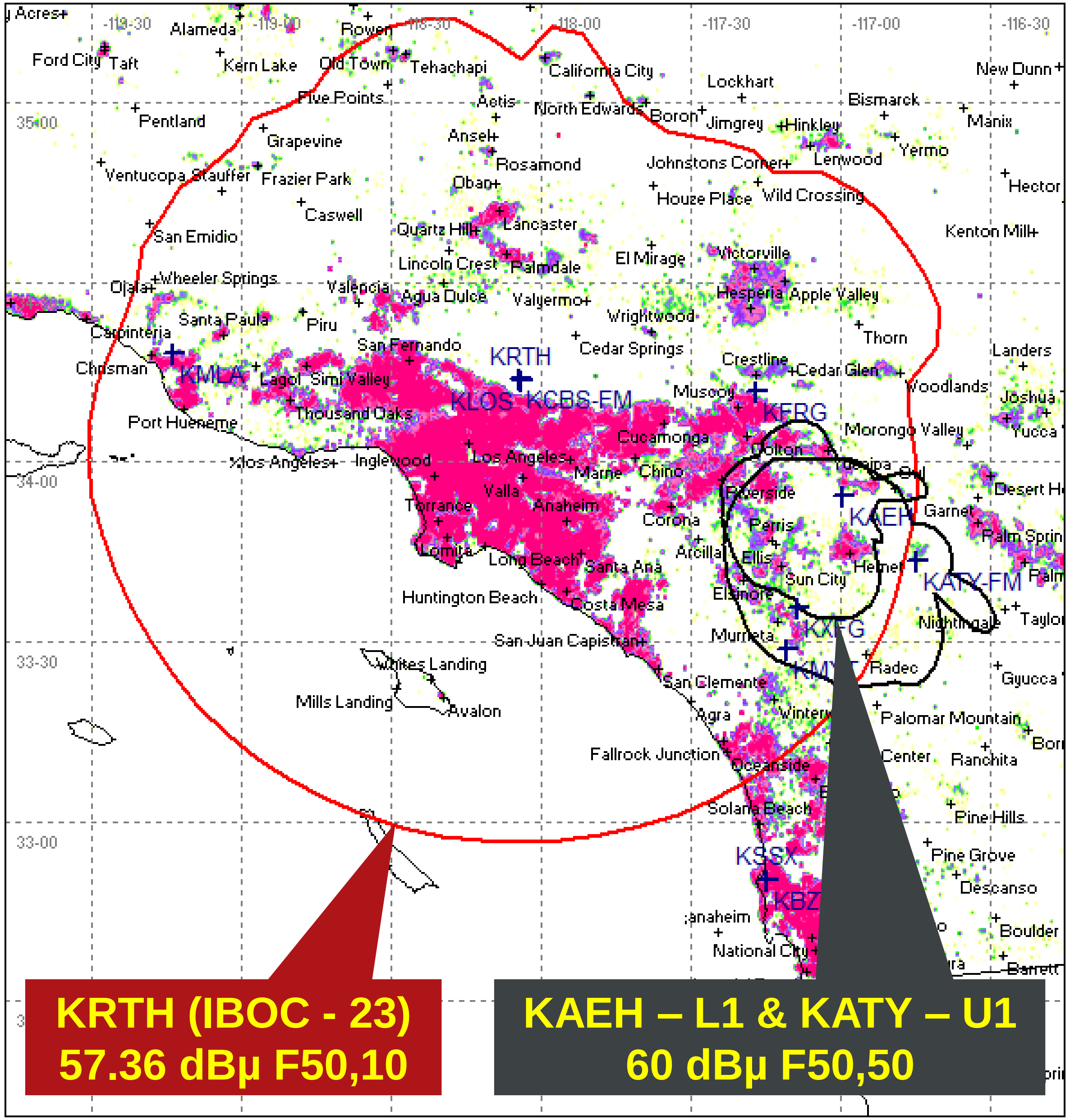
These stations that have created a "test bed" for the subjective effects of IBOC into an analog first-adjacent neighbor. About half of those stations are shown in the following slides:

KRTH (Los Angeles)

Physical Short Spacing

KRTH's IBOC F50,10 interfering contour is plotted at 57.3656 dBu (-23 dBc Level)
KAEH (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **44.4 dB** above the 57.3656 dBu level set for -23 dBc

KATY (Upper 1st) = 60 dBu (F50,50) receives interference **42.6 dB** above the -23 dBc level



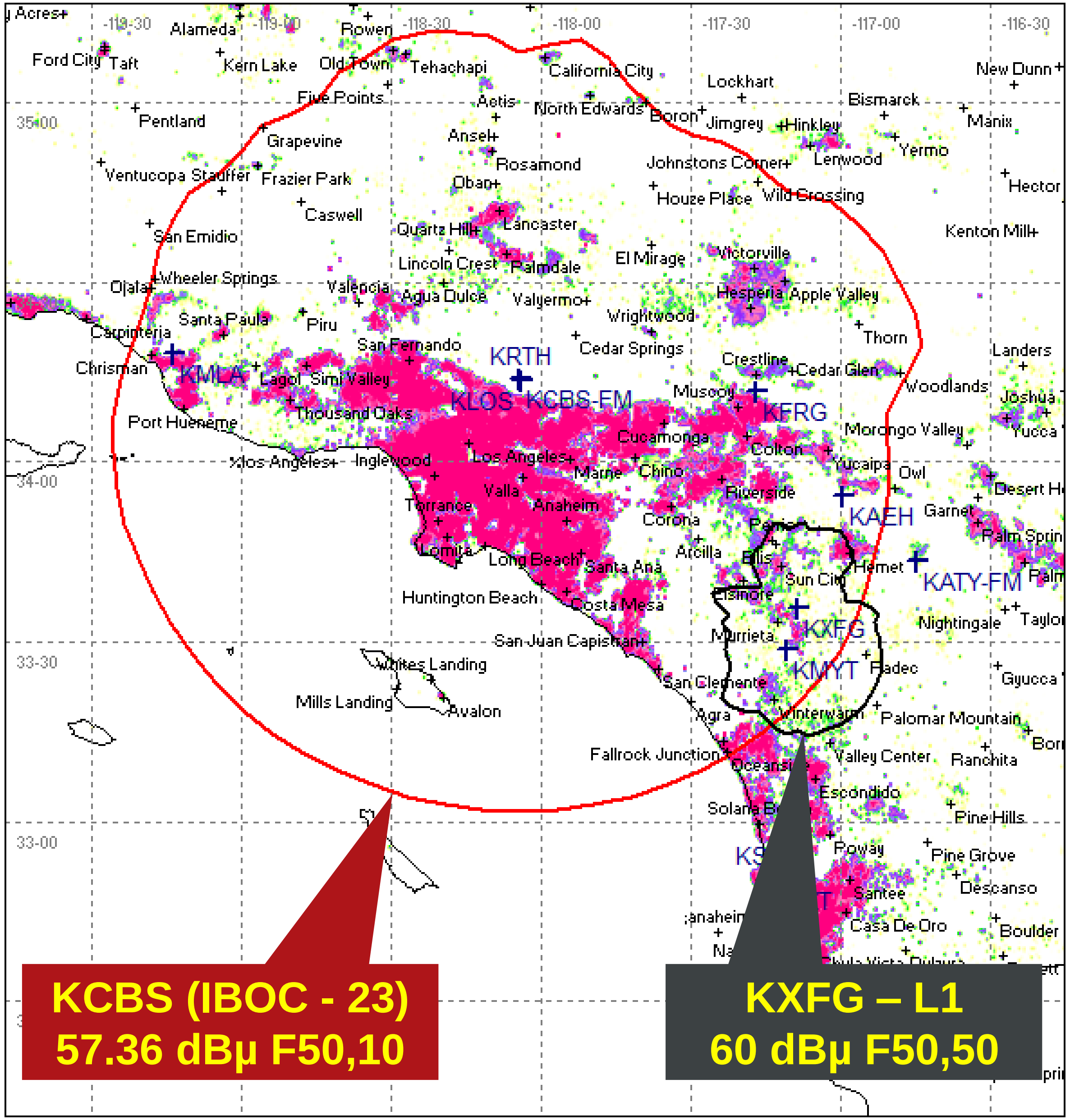
KCBS (Los Angeles)

Physical Short Spacing

Is also limited to -23 dBc by the FCC IBOC “Super-B” rule

KCBS’s IBOC F50,10 interfering contour is also plotted at 57.3656 dBu

KXFG (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **31.4** dB above the 57.3656 dBu level set for -23 dBc



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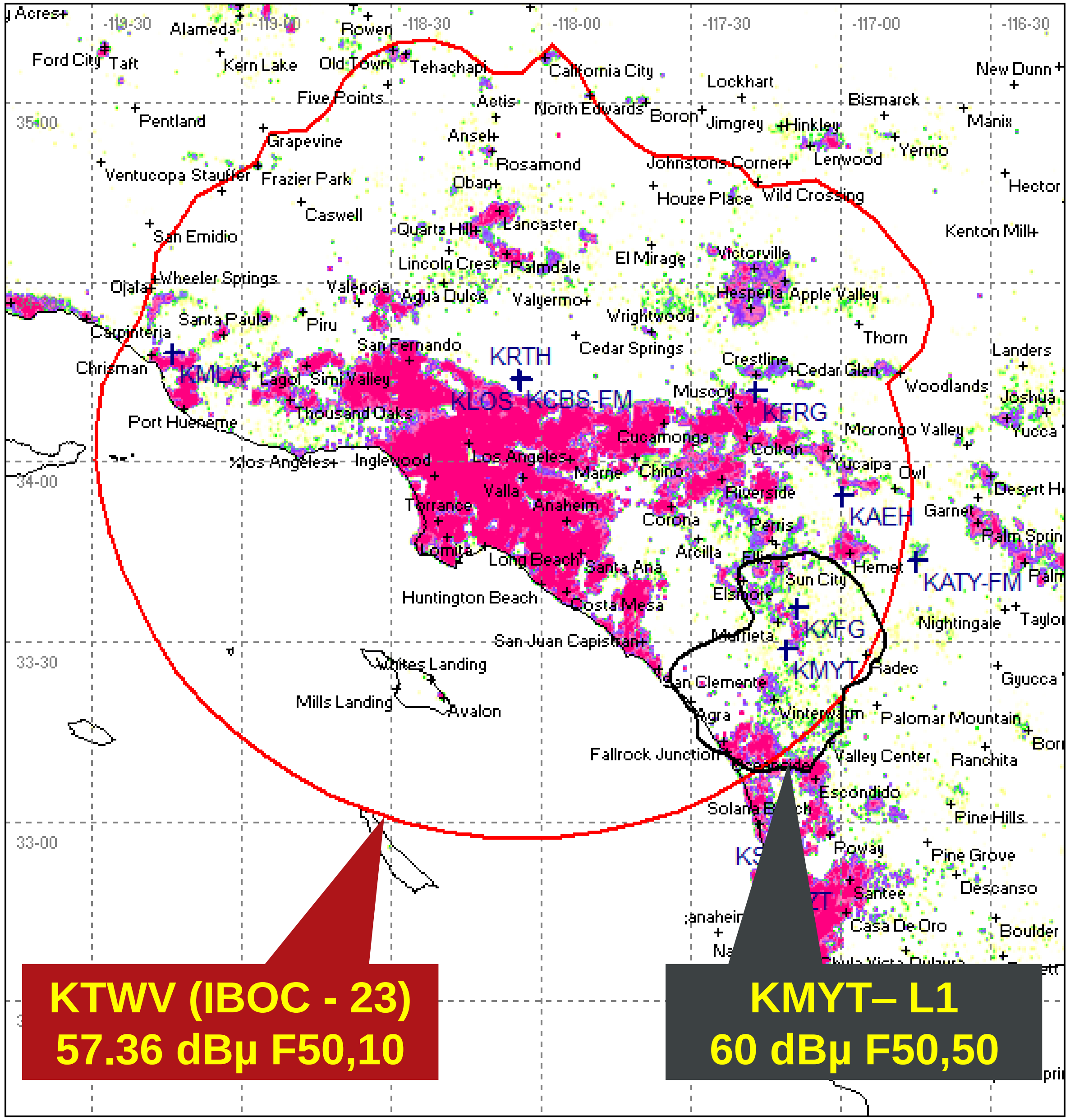
KTWV (Los Angeles)

Physical Short Spacing

Is limited to -23 dBc by the FCC IBOC "Super-B" rule

KTWV's IBOC F50,10 interfering contour is plotted at 57.3656 dBu

KMYT (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **25.2** dB above the 57.3656 dBu level set for -23 dBc

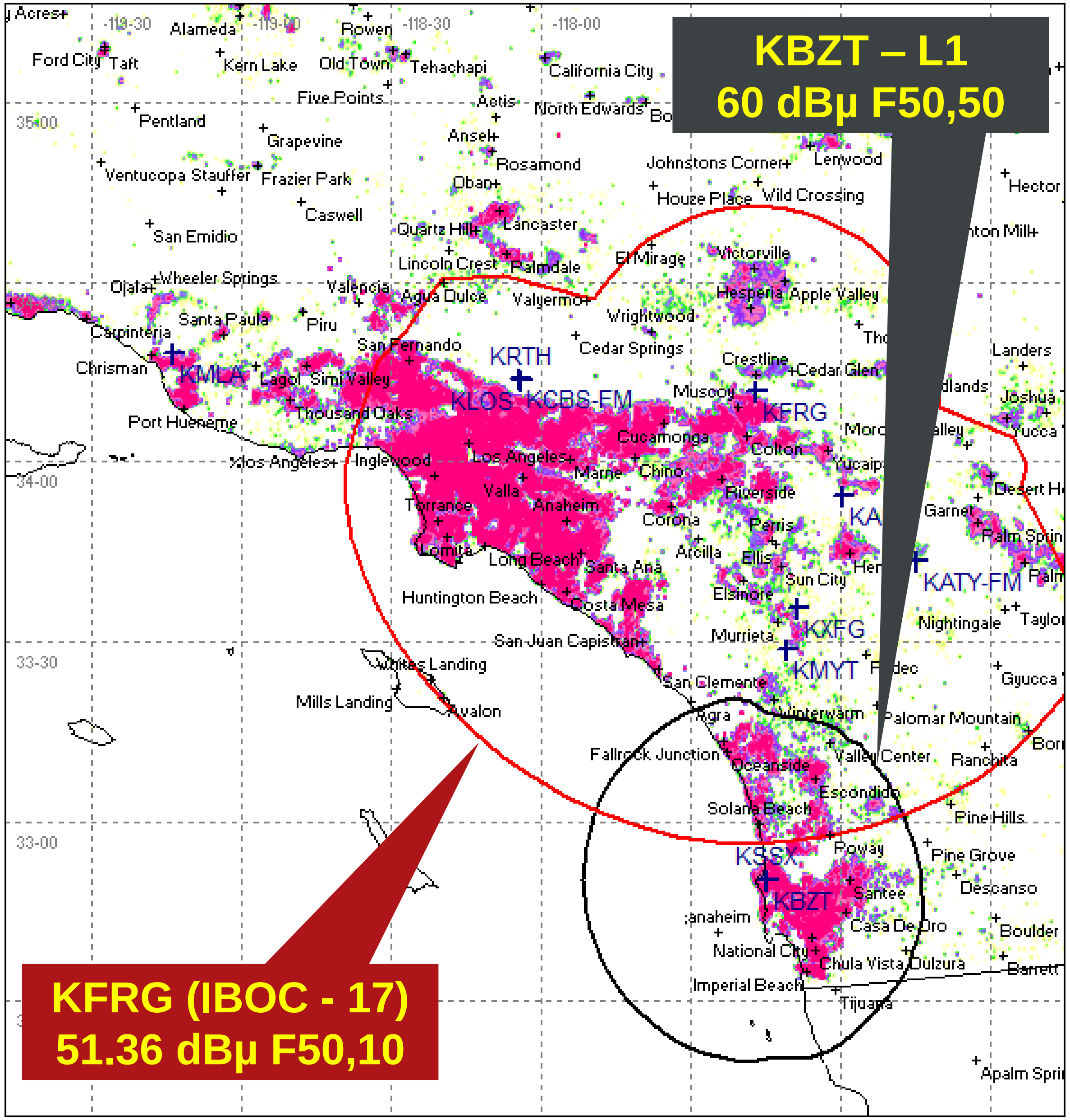


KFRG (Los Angeles)

Physical Short Spacing

KFRG's IBOC F50,10 interfering contour is plotted at 51.3656 dBu

KBZT (Lower 1st) @ its 60 dBu (F50,50)
receives IBOC interference **26.4** dB above the 51.3656 dBu level set for -17 dBc



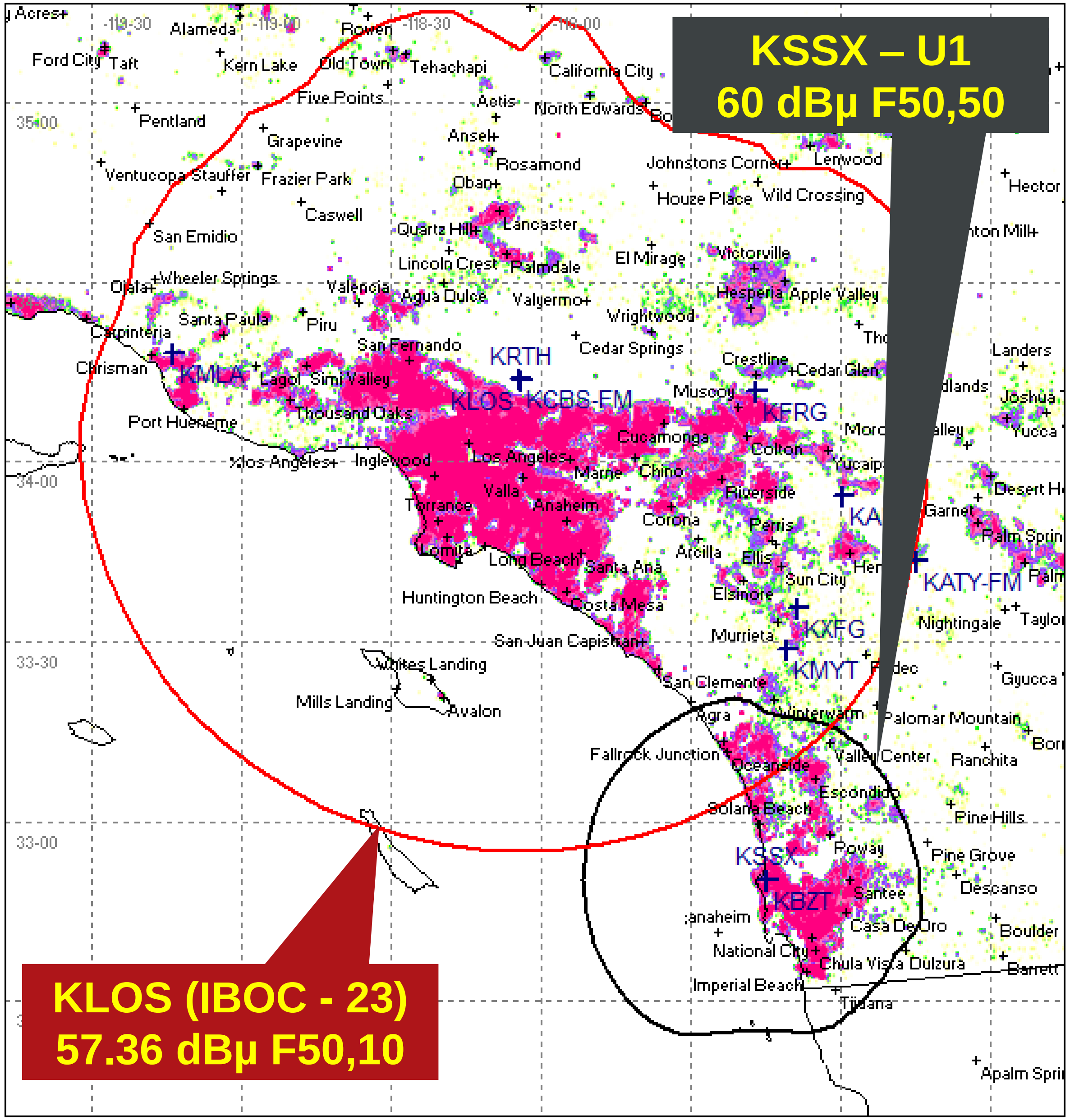
KLOS (Los Angeles)

Physical Short Spacing

Is limited to -23 dBc by the FCC IBOC "Super-B" rule

KLOS's IBOC F50,10 interfering contour is plotted at 57.3656 dBu

KSSX (Upper 1st) @ its 60 dBu (F50,50)
receives IBOC interference **27.8** dB above the 57.3656 dBu level set for -23 dBc



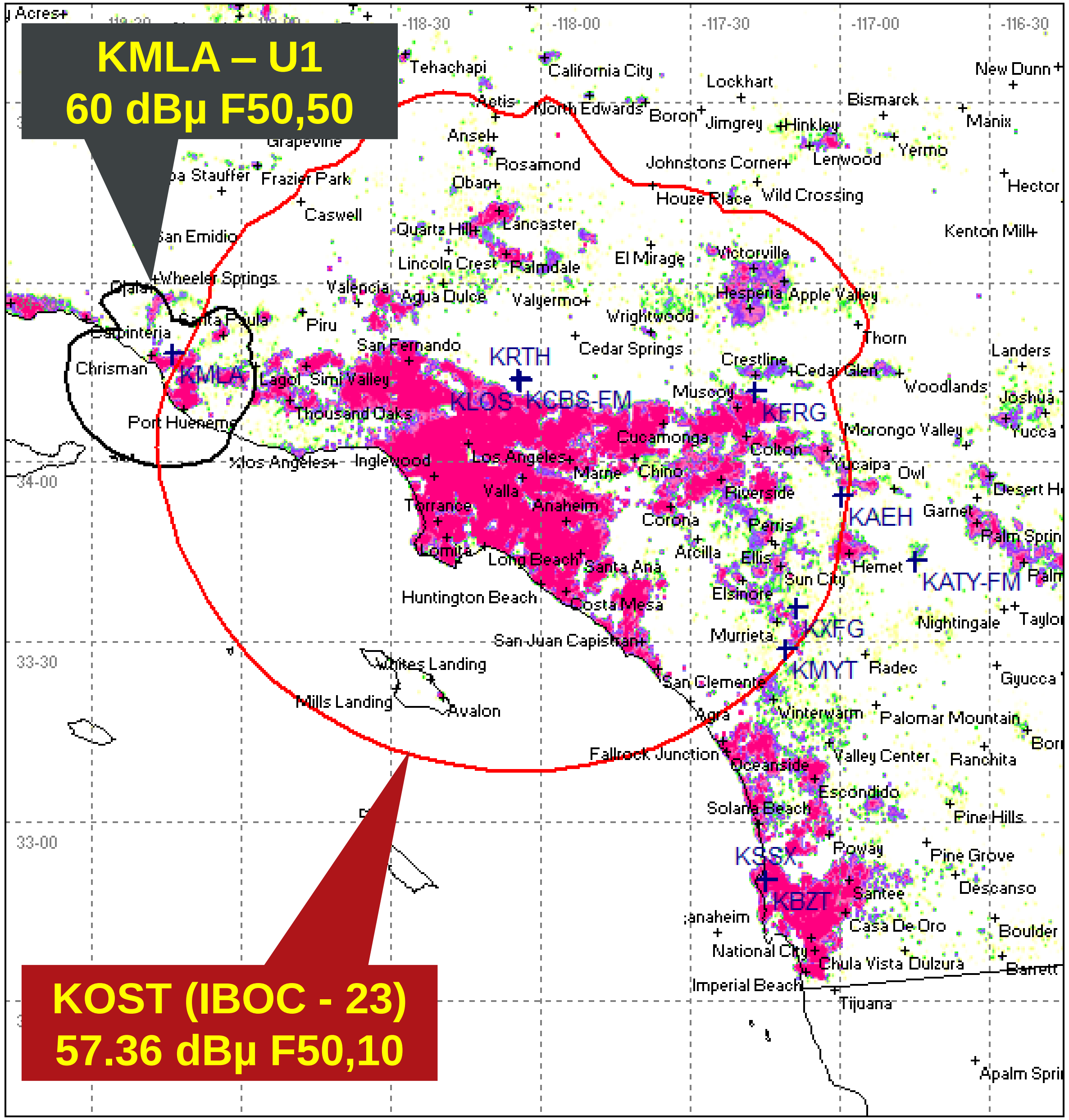
KOST (Los Angeles)

Physical Short Spacing

Is limited to -23 dBc by the FCC IBOC "Super-B" rule

KOST's IBOC F50,10 interfering contour is plotted at 57.3656 dBu

KMLA (Upper 1st) @ its 60 dBu (F50,50)
receives IBOC interference **21.5** dB above the 57.3656 dBu level set for -23 dBc



XPERI

KSKS

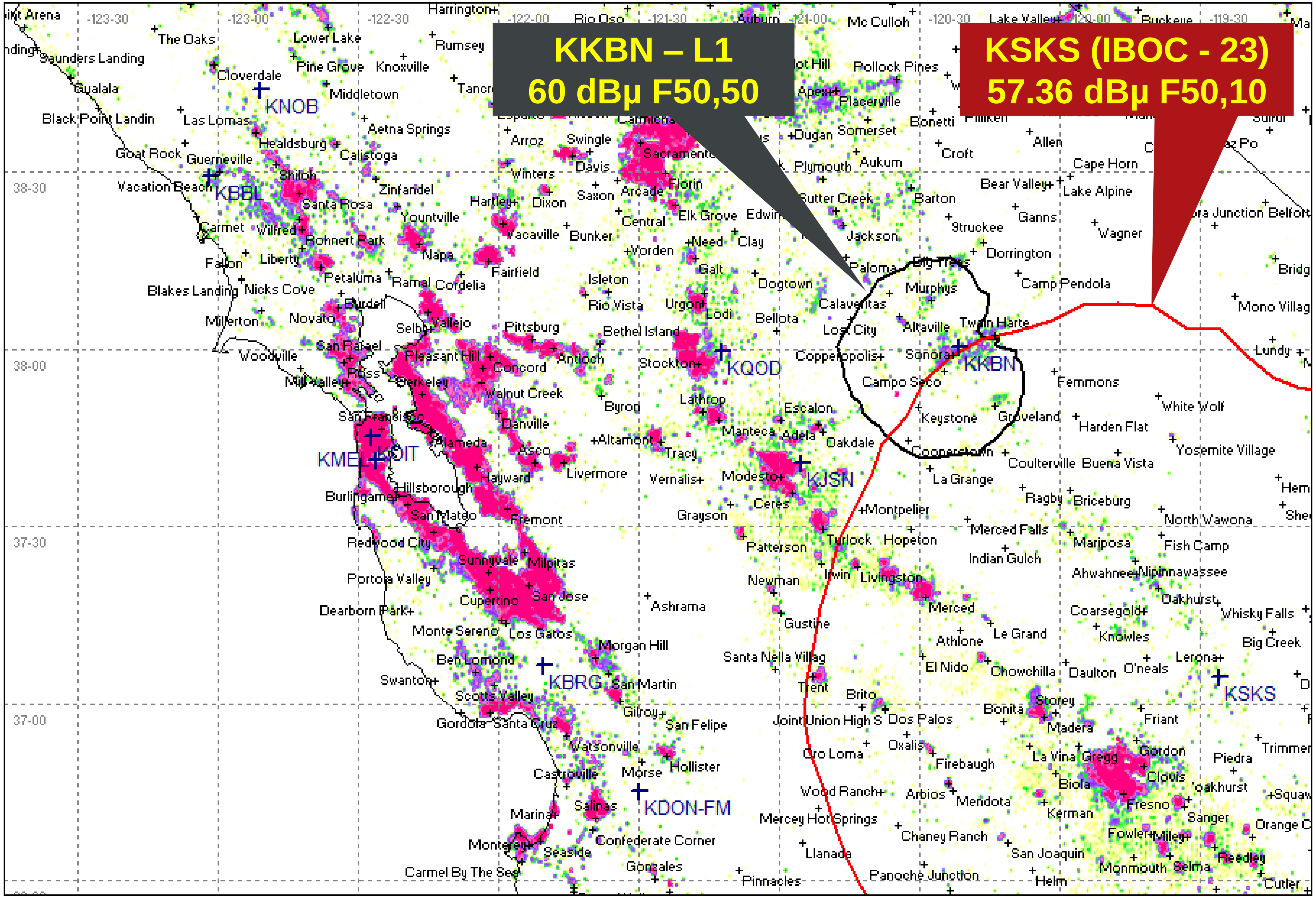
(San Francisco)

Physical Short Spacing

Is limited to -23 dBc by the FCC IBOC “Super-B” rule

KSKS’s IBOC F50,10 interfering contour is plotted at 57.3656 dBu

KKBN (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **25.4** dB above the 57.3656 dBu level set for -23 dBc



XPERI

KOIT

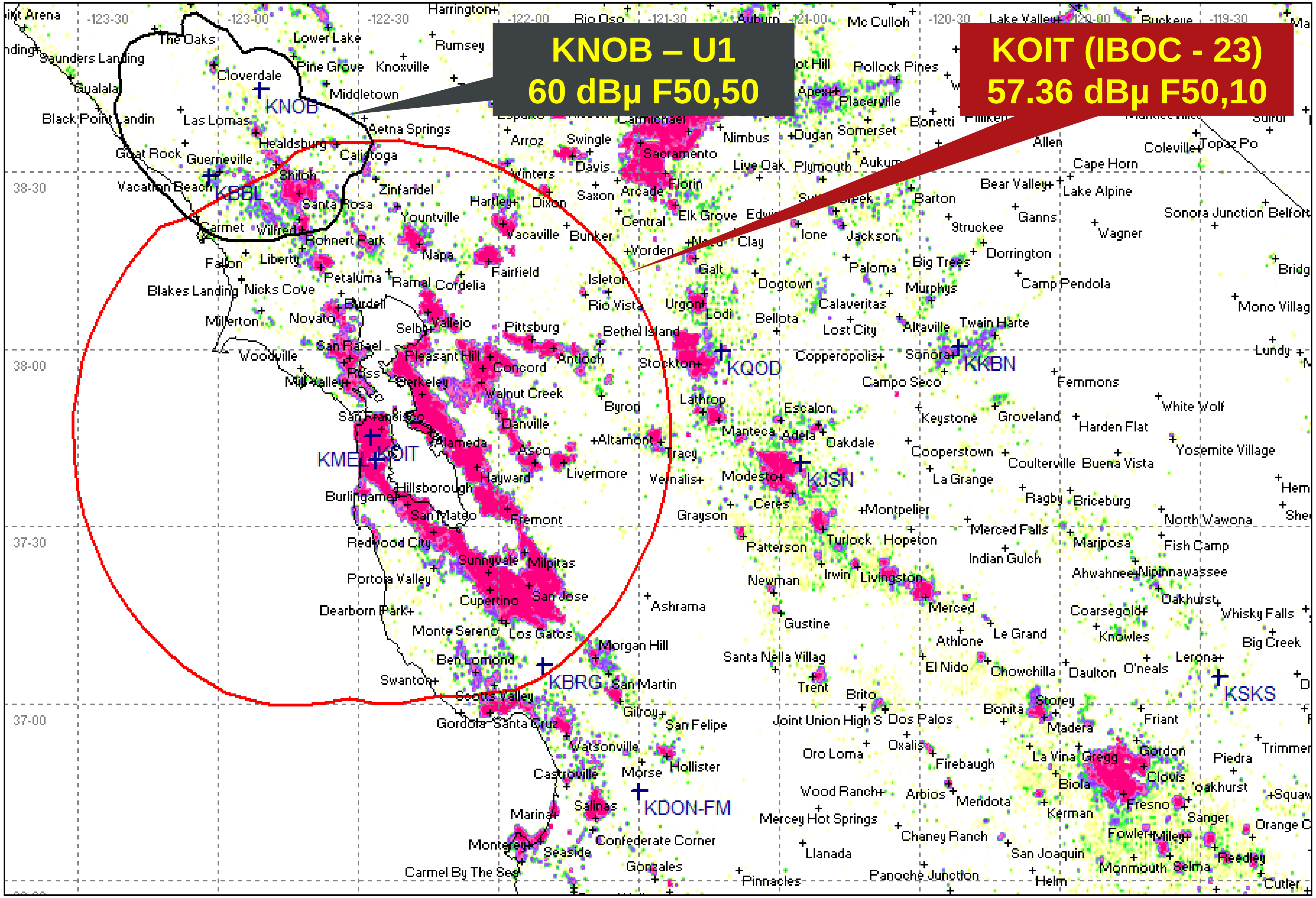
(San Francisco)

Physical Short Spacing

Is limited to -23 dBc by the FCC IBOC “Super-B” rule

KOIT’s IBOC F50,10 interfering contour is plotted at 57.3656 dBu

KNOB (Upper 1st) @ its 60 dBu (F50,50) receives IBOC interference **24.7** dB above the 57.3656 dBu level set for -23 dBc



KBRG

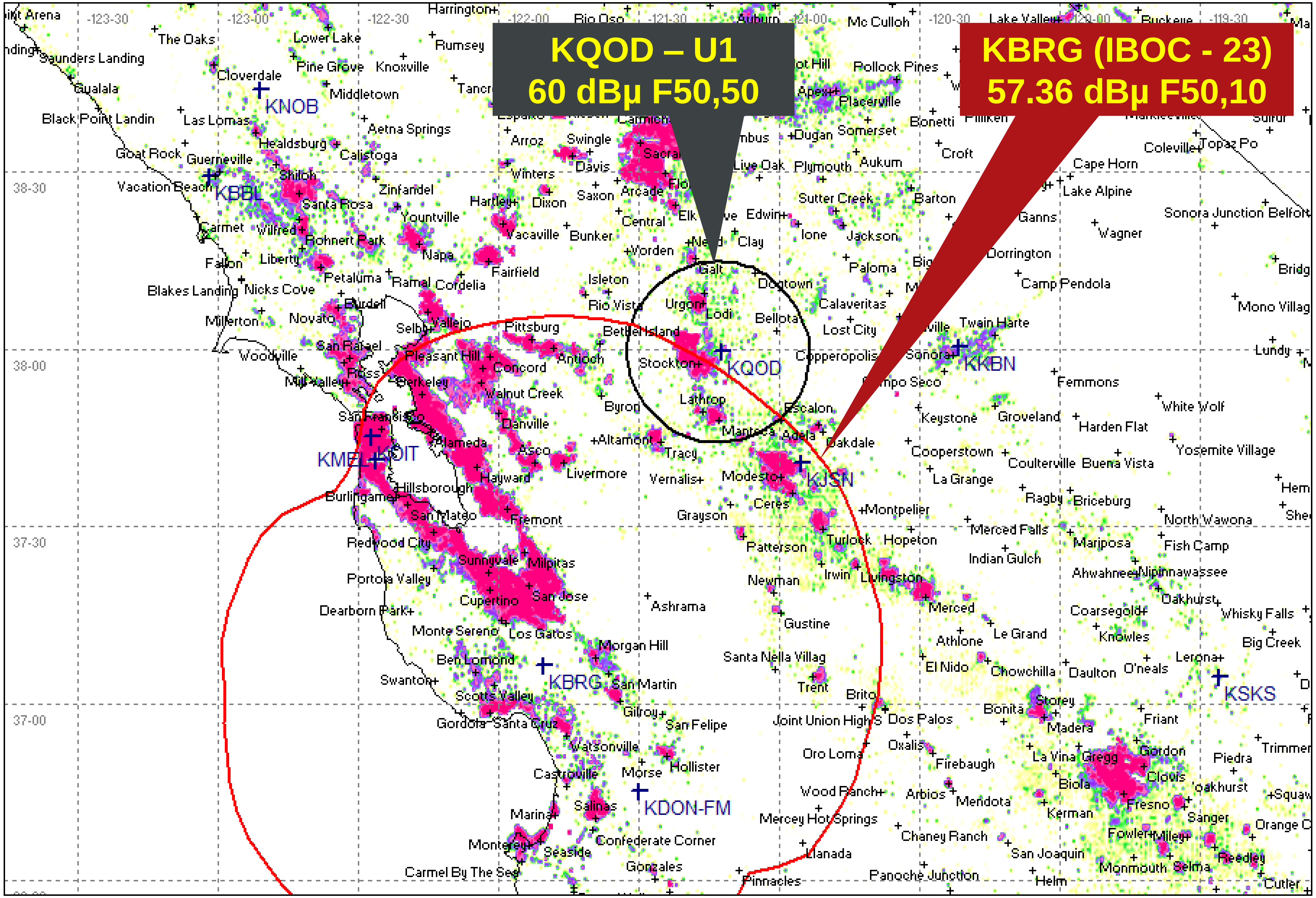
(San Francisco)

Physical Short Spacing

Is also limited to -23 dBc by the FCC IBOC "Super-B" rule

KBRG's (Upper 1st) IBOC F50,10 interfering contour is plotted at 57.3656 dBu

KQOD (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **24.3** dB above the 57.3656 dBu level set for -23 dBc



XPERI

KMEL

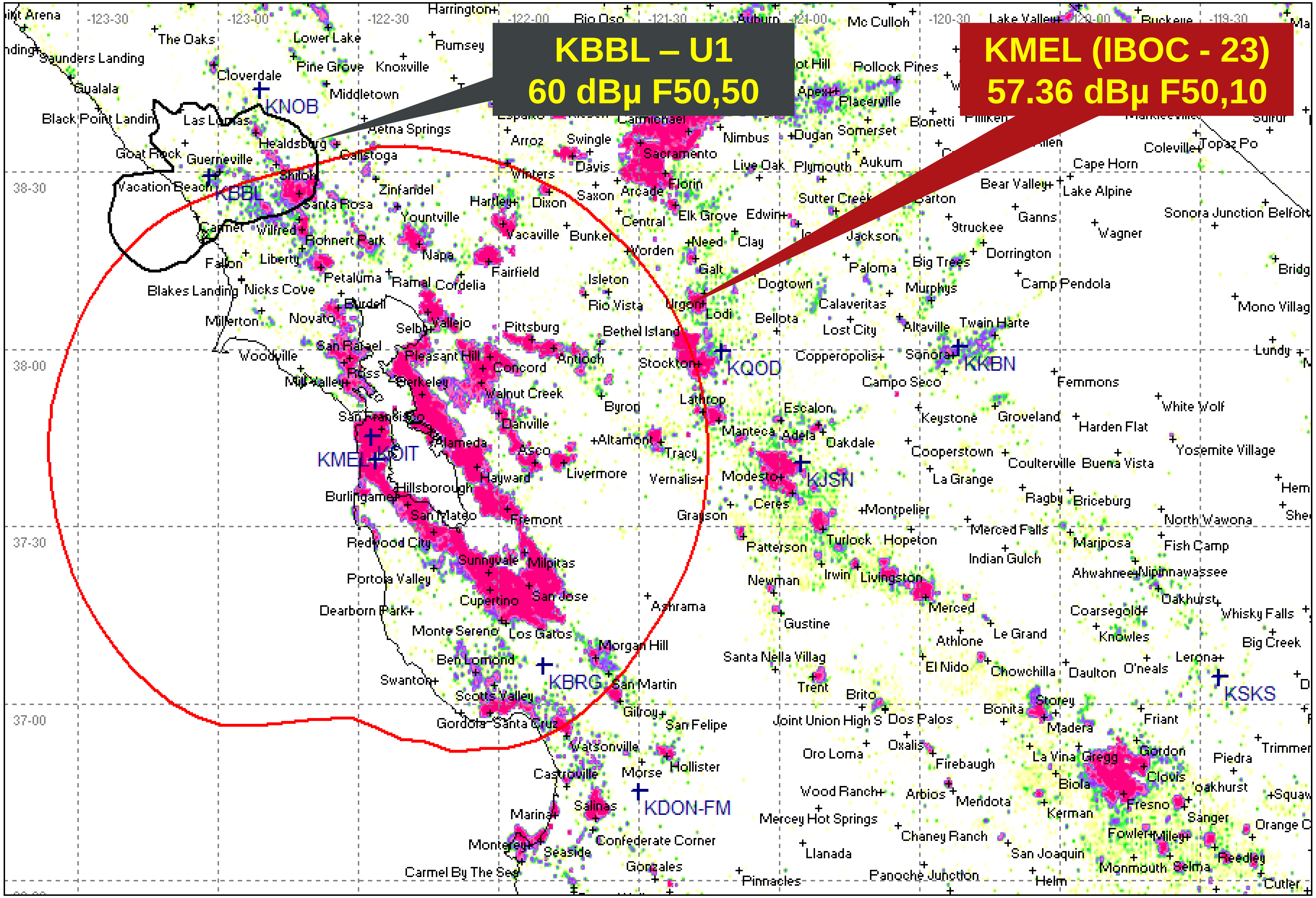
(San Francisco)

Physical Short Spacing

Is also limited to -23 dBc by the FCC IBOC “Super-B” rule

KMEL’s IBOC F50,10 interfering contour is plotted at 57.3656 dBu

KBBL (Upper 1st) @ its 60 dBu (F50,50) receives IBOC interference **21.9** dB above the 57.3656 dBu level set for -23 dBc



KDON

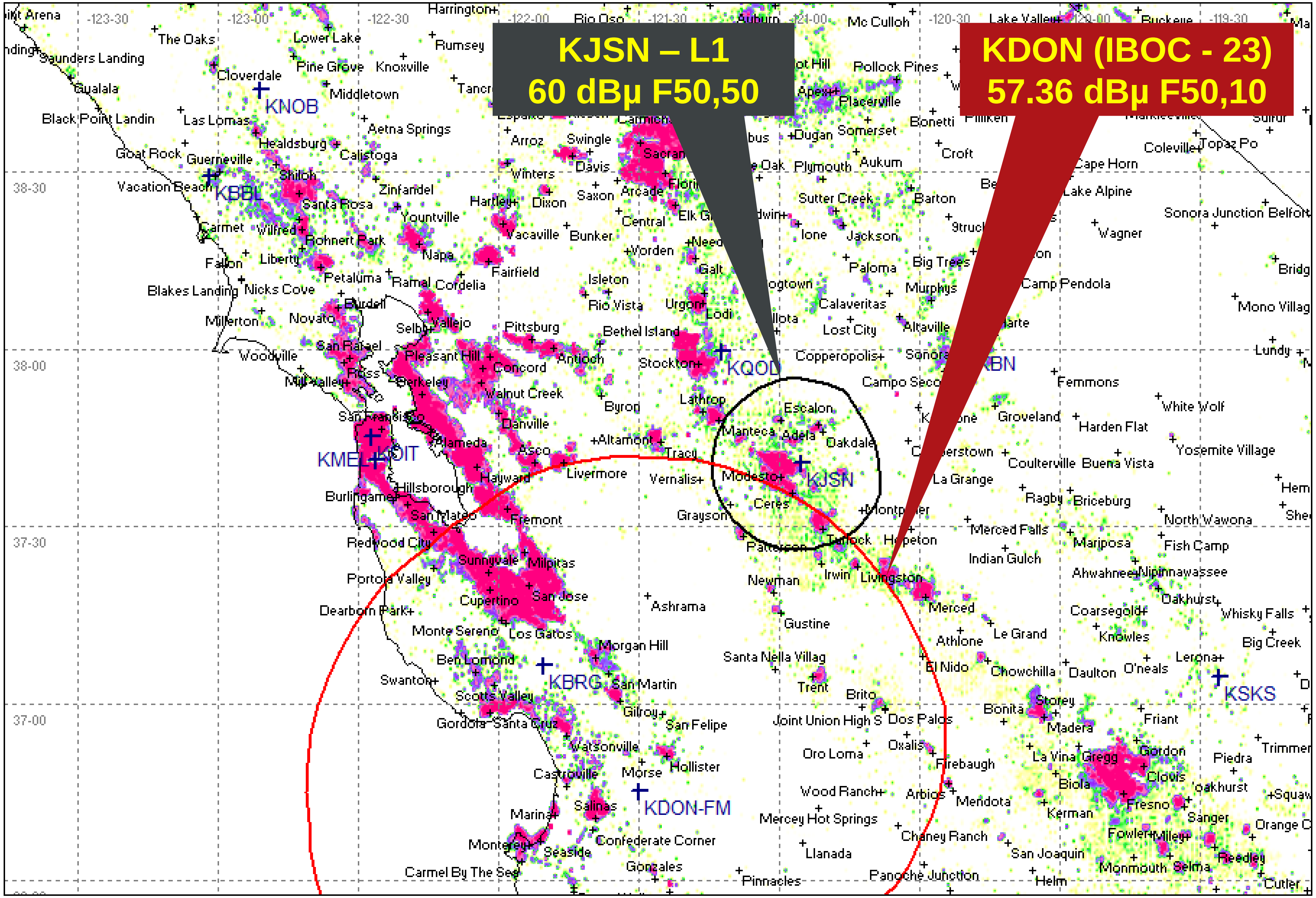
(San Francisco)

Physical Short Spacing

Is also limited to -23 dBc by the FCC IBOC “Super-B” rule

KDON’s IBOC F50,10 interfering contour is plotted at 57.3656 dBu

KJSN (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **20.8** dB above the 57.3656 dBu level set for -23 dBc



XPERI

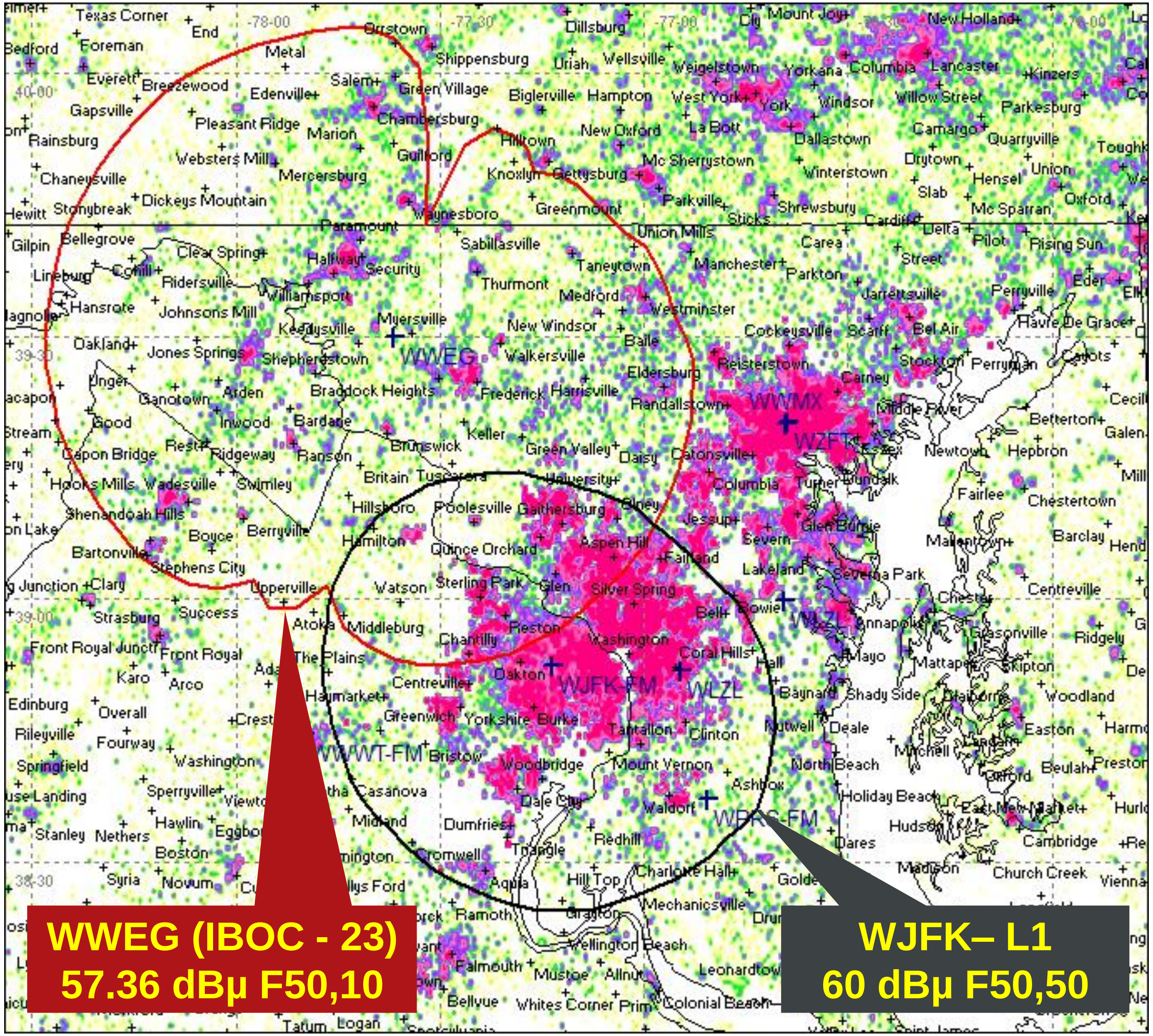
WWEG (Balt / Wash)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -23 dBc / Sideband

WWEG’s IBOC F50,10 interfering contour plotted at 57.3656 dBu

WJFK (Lower 1st) @ its 60 dBu (F50,50)
receives IBOC interference **42.7 dB** above the 57.3656 dBu level set for -23 dBc



WJFK (Balt / Wash)

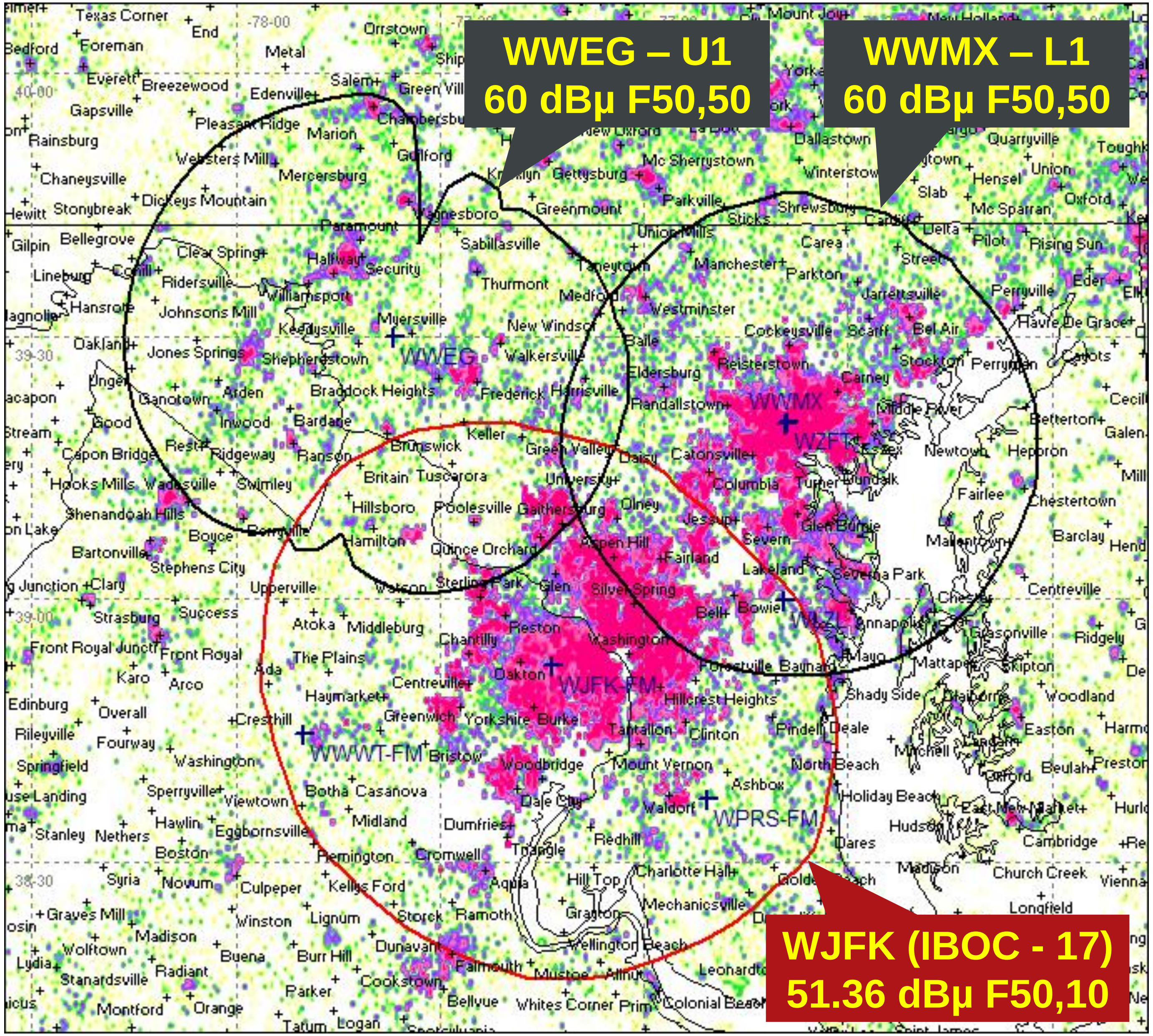
Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -17 dBc / Sideband

WJFK’s IBOC F50,10 interfering contour plotted at 51.3656 dBu

WWMX (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference 42.4 dB above the 51.3656 dBu level set for -17 dBc

WWEG (Upper 1st) @ its 60 dBu (F50,50) receives IBOC interference ***53.1*** dB above the 51.3656 dBu level set for -17 dBc



XPERI

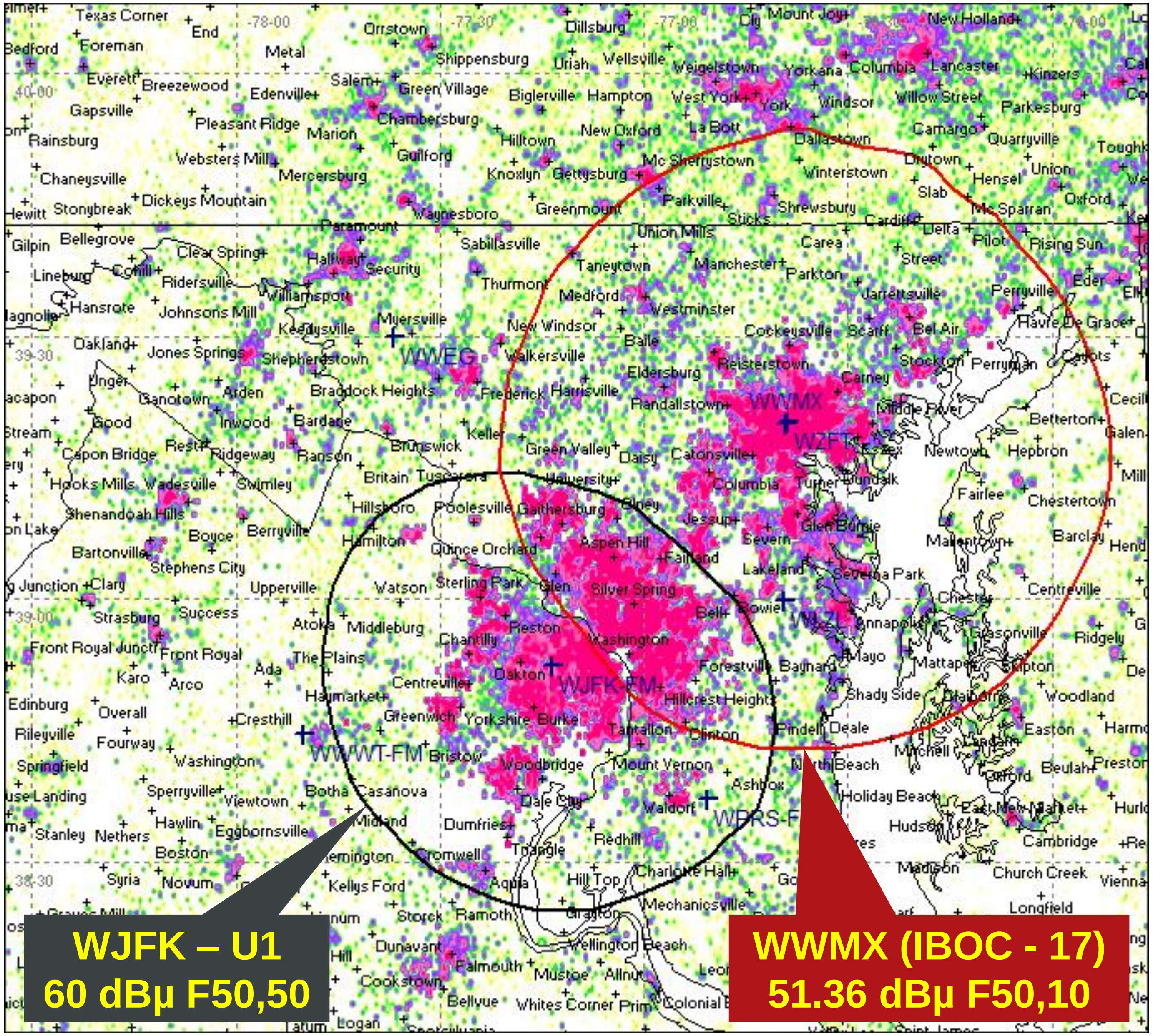
WWMX (Balt / Wash)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -17 dBc / Sideband

WWMX’s IBOC F50,10 interfering contour plotted at 51.3656 dBu

WJFK (Upper 1st) @ its 60 dBu (F50,50) receives IBOC interference **33.9 dB** above the 51.3656 dBu level set for -23 dBc



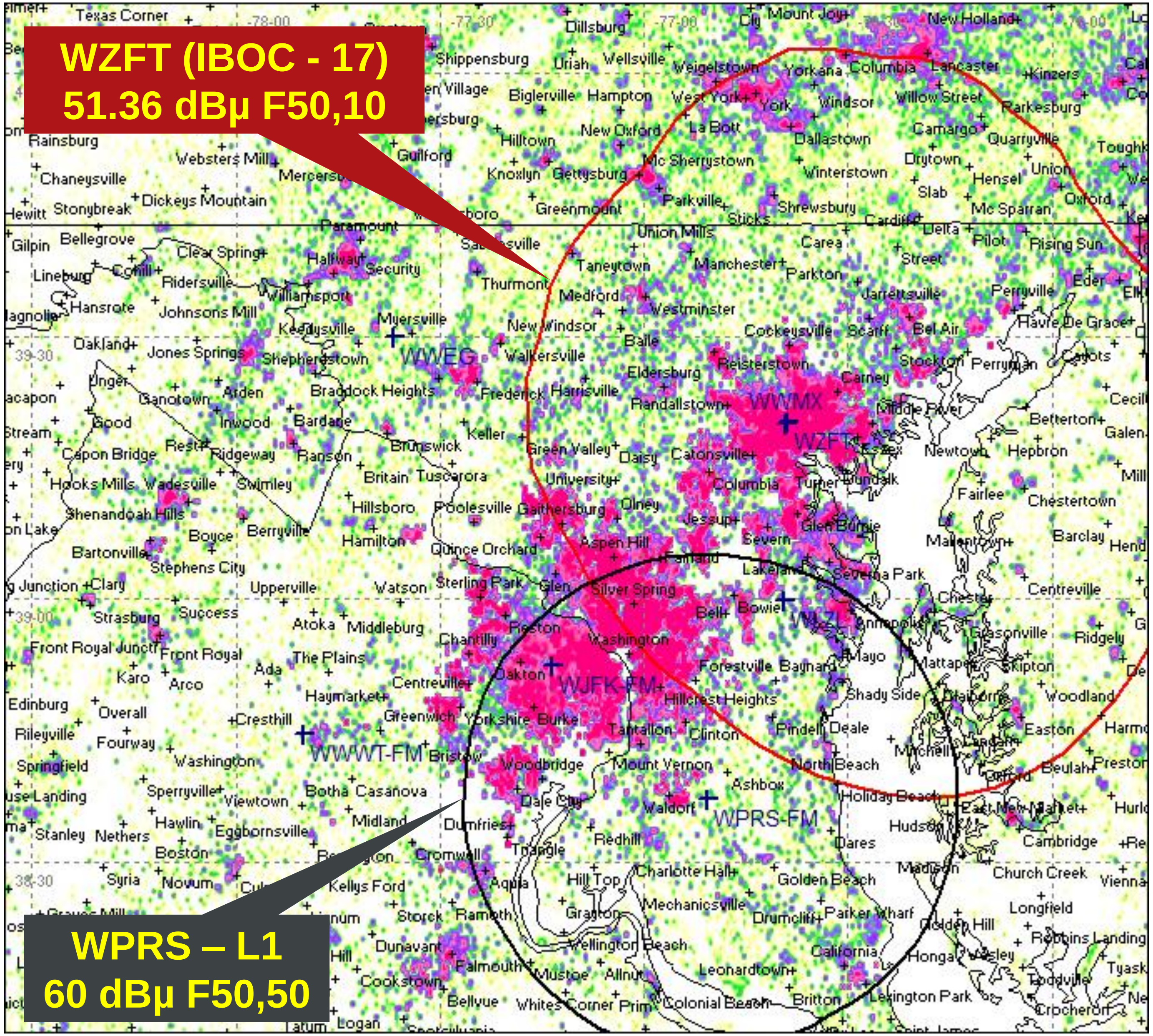
WZFT (Balt / Wash)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -17 dBc / Sideband

WZFT's IBOC F50,10 interfering contour is plotted at 51.3656 dBu

WPRS (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **33.3 dB** above the 51.3656 dBu level set for -17 dBc



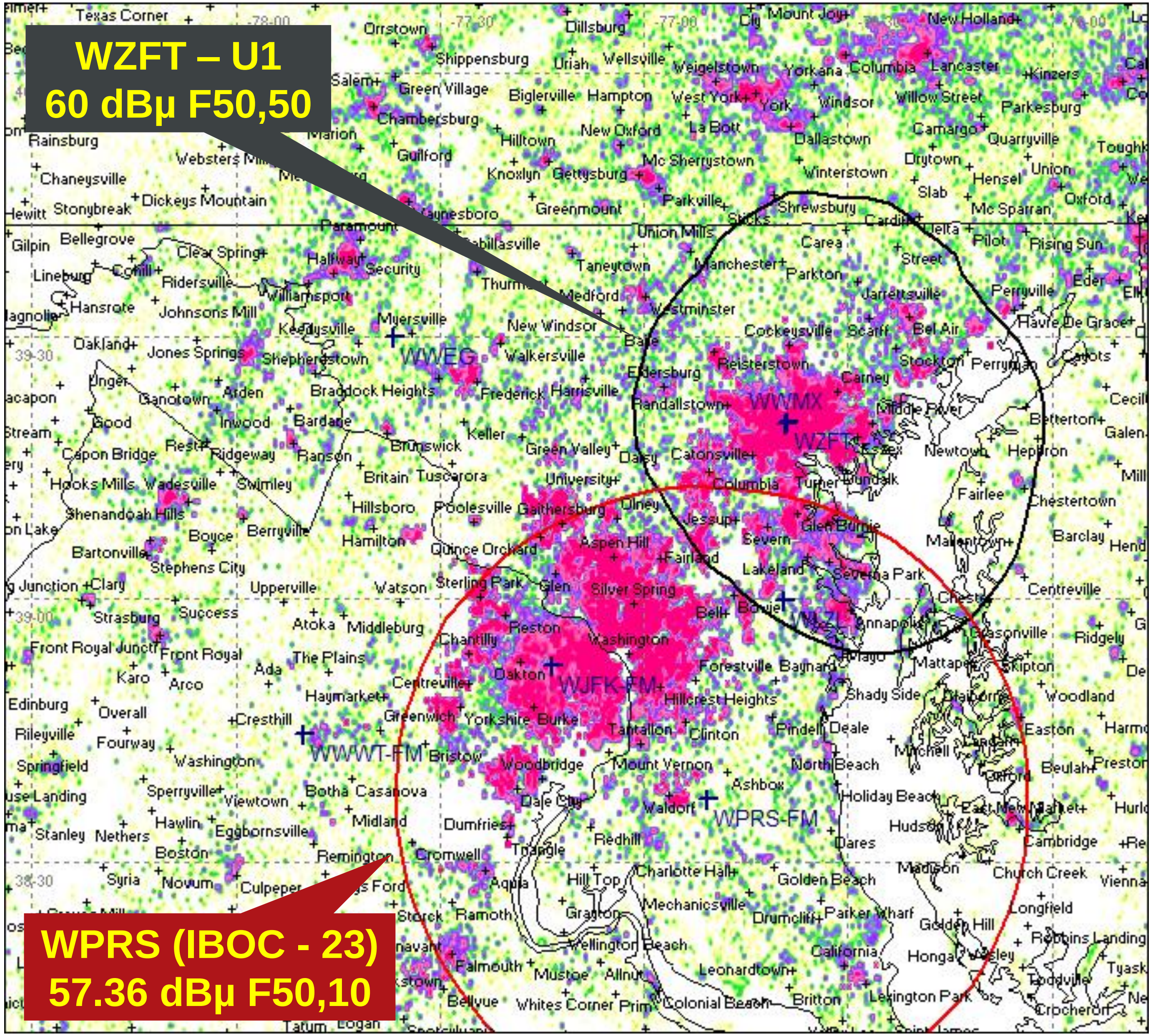
WPRS (Balt / Wash)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -23 dBc / Sideband

WPRS's IBOC F50,10 interfering contour plotted at 57.3656 dBu

WZFT (Upper 1st) @ its 60 dBu (F50,50) receives IBOC interference **28.4** dB above the 57.3656 dBu level set for -23 dBc



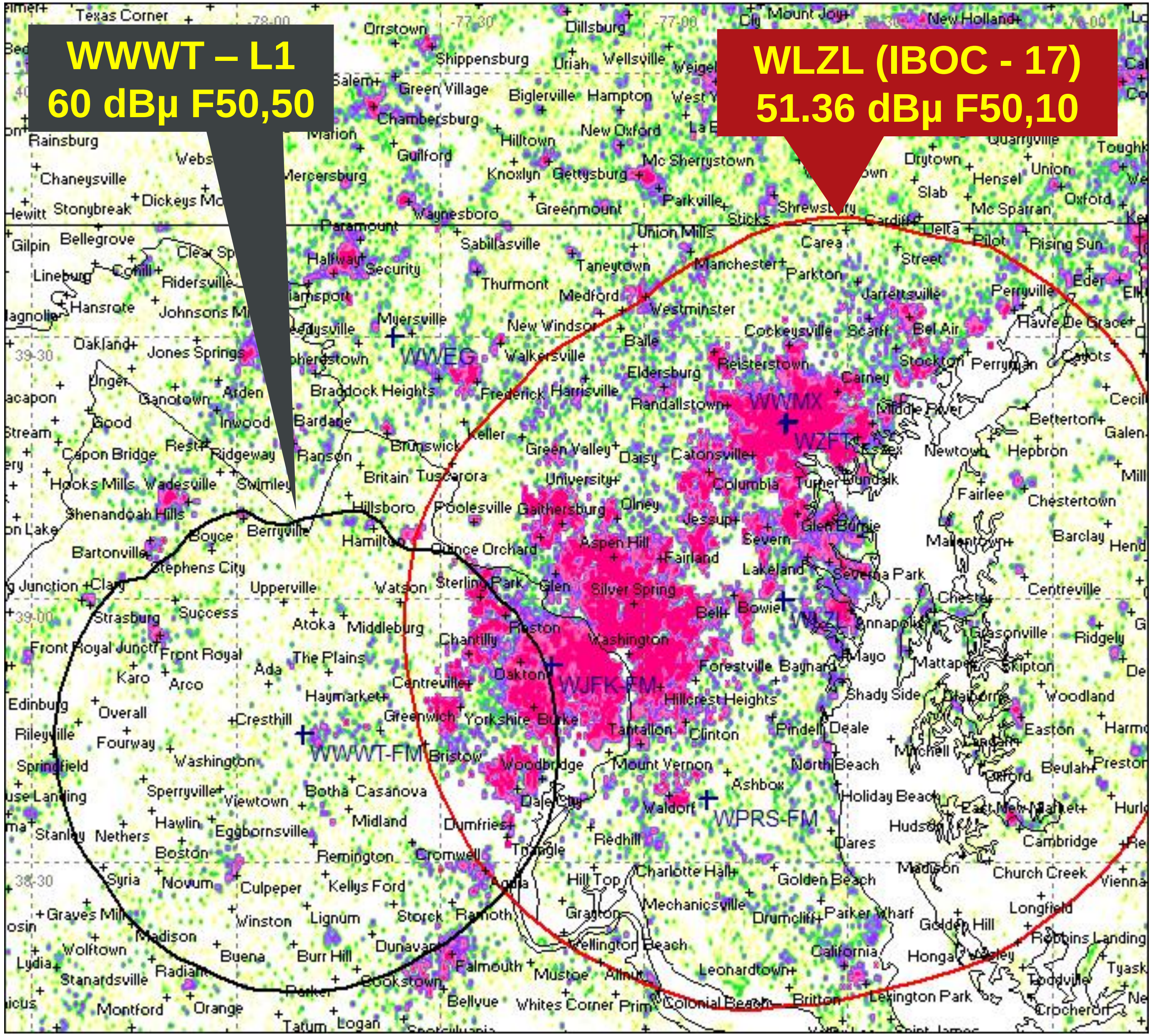
WLZL (Balt / Wash)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -17 dBc / Sideband

WLZL's IBOC F50,10 interfering contour is plotted at 51.3656 dBu

WWWT (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **22.7** dB above the 51.3656 dBu level set for -17 dBc



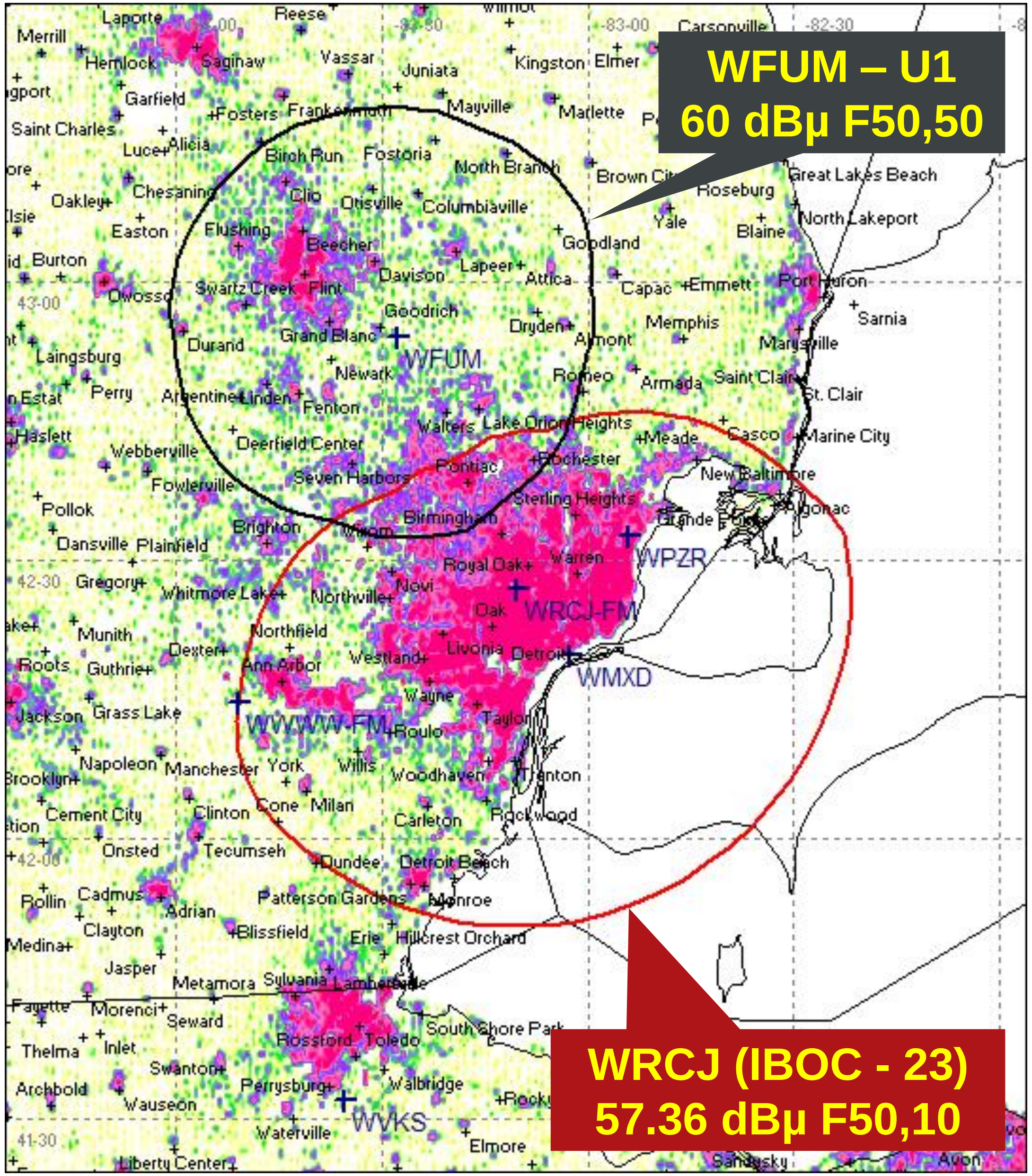
WRCJ (Detroit)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -23 dBc / Sideband

WRCJ’s IBOC F50,10 interfering contour is plotted at 57.3656 dBu

WFUM (Upper 1st) @ its 60 dBu (F50,50) receives IBOC interference **30.6** dB above the 57.3656 dBu level set for -23 dBc



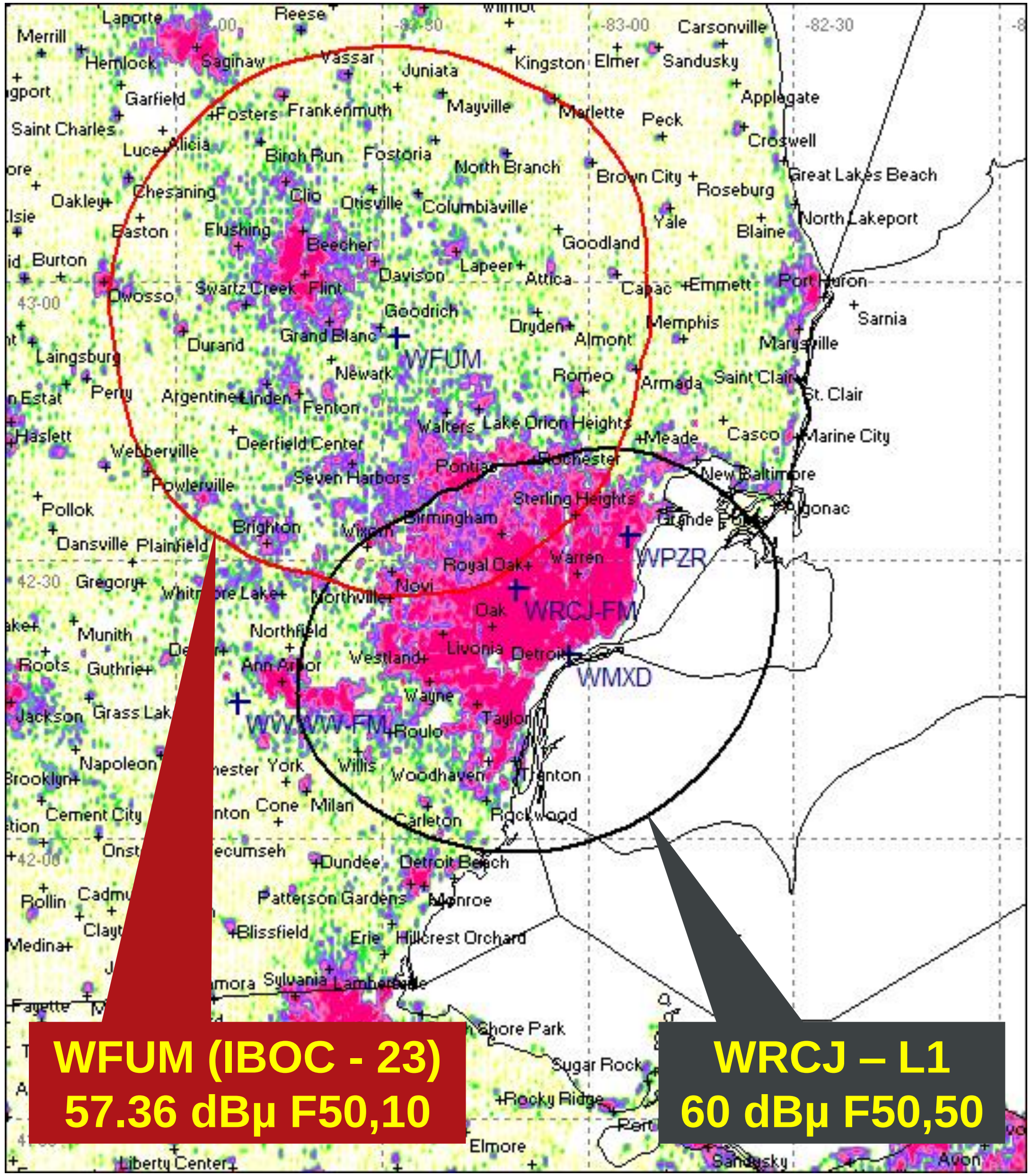
WFUM (Detroit)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -23 dBc / Sideband

WFUM's IBOC F50,10 interfering contour is plotted at 57.3656 dBu

WRCJ (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **26.8** dB above the 57.3656 dBu level set for -23 dBc



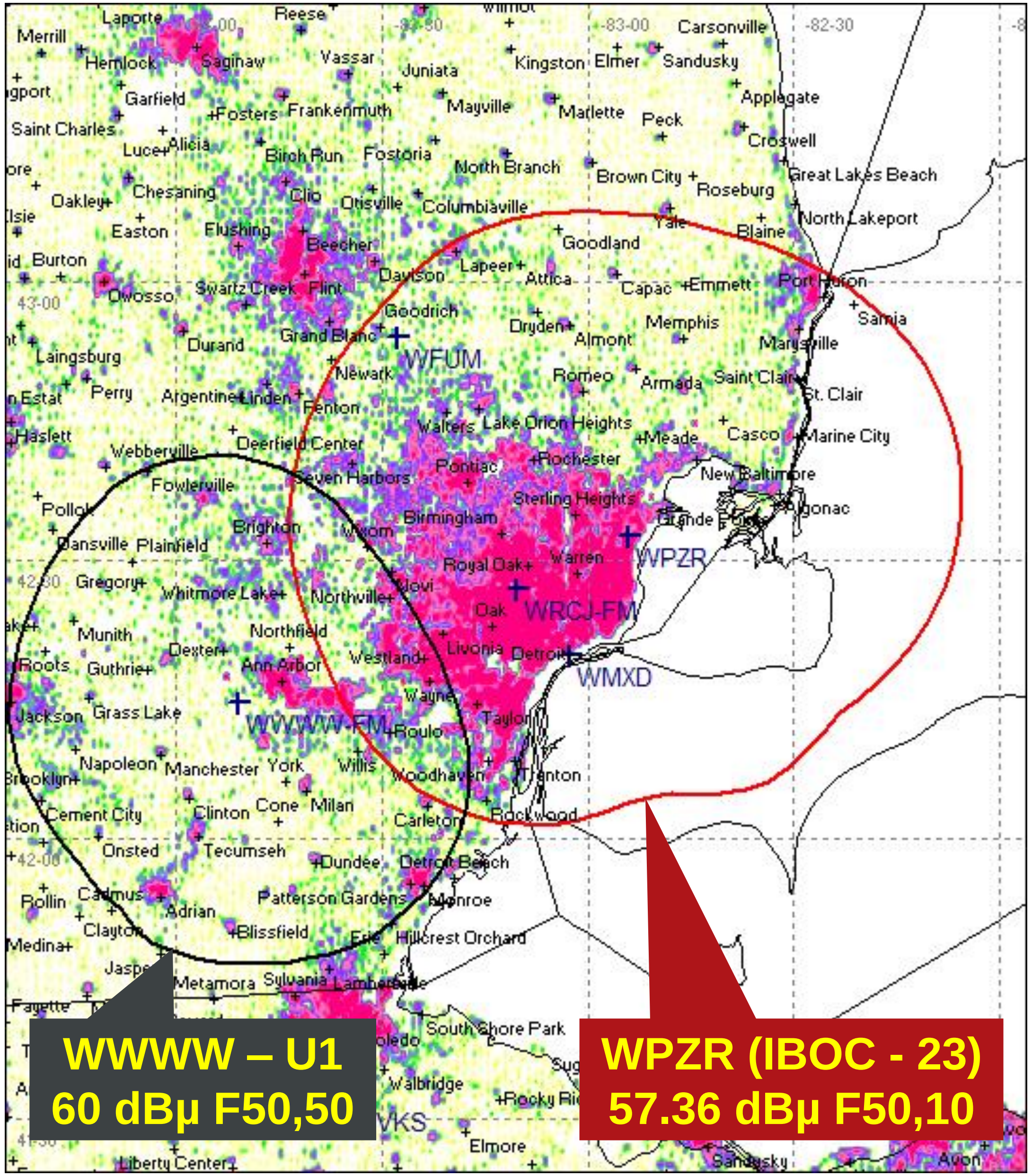
<u>**WPZR** (Detroit)</u>

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -23 dBc / Sideband

WPZR's IBOC F50,10 interfering contour is plotted at 57.3656 dBu

WWWW (Upper 1st) @ its 60 dBu (F50,50) receives IBOC interference **26.3** dB above the 57.3656 dBu level set for -23 dBc



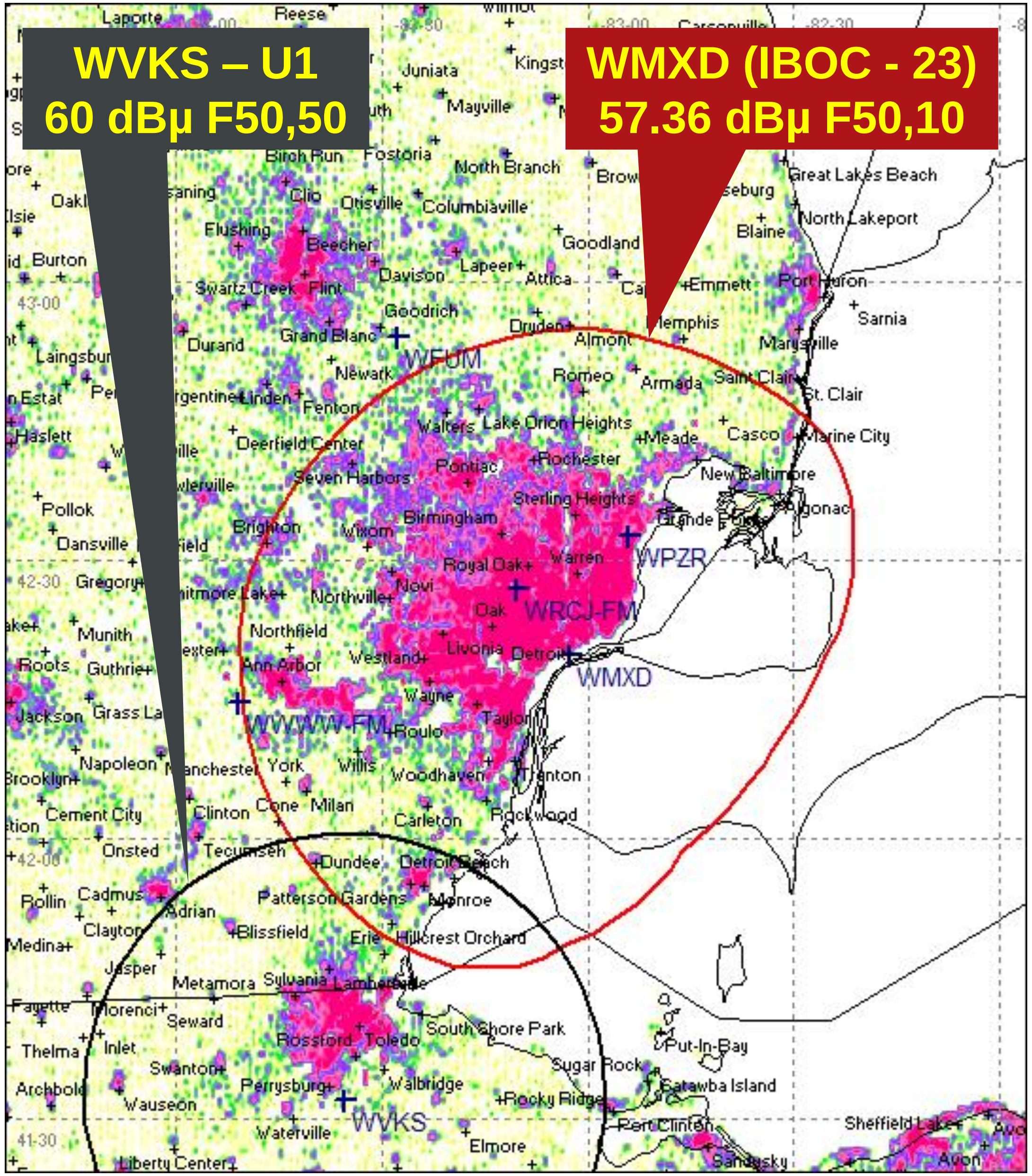
WMXD (Detroit)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -23 dBc / Sideband

WMXD's IBOC F50,10 interfering contour is plotted at 57.3656 dBu

WVKS (Upper 1st) @ its 60 dBu (F50,50) receives IBOC interference **24.1** dB above the 57.3656 dBu level set for -23 dBc



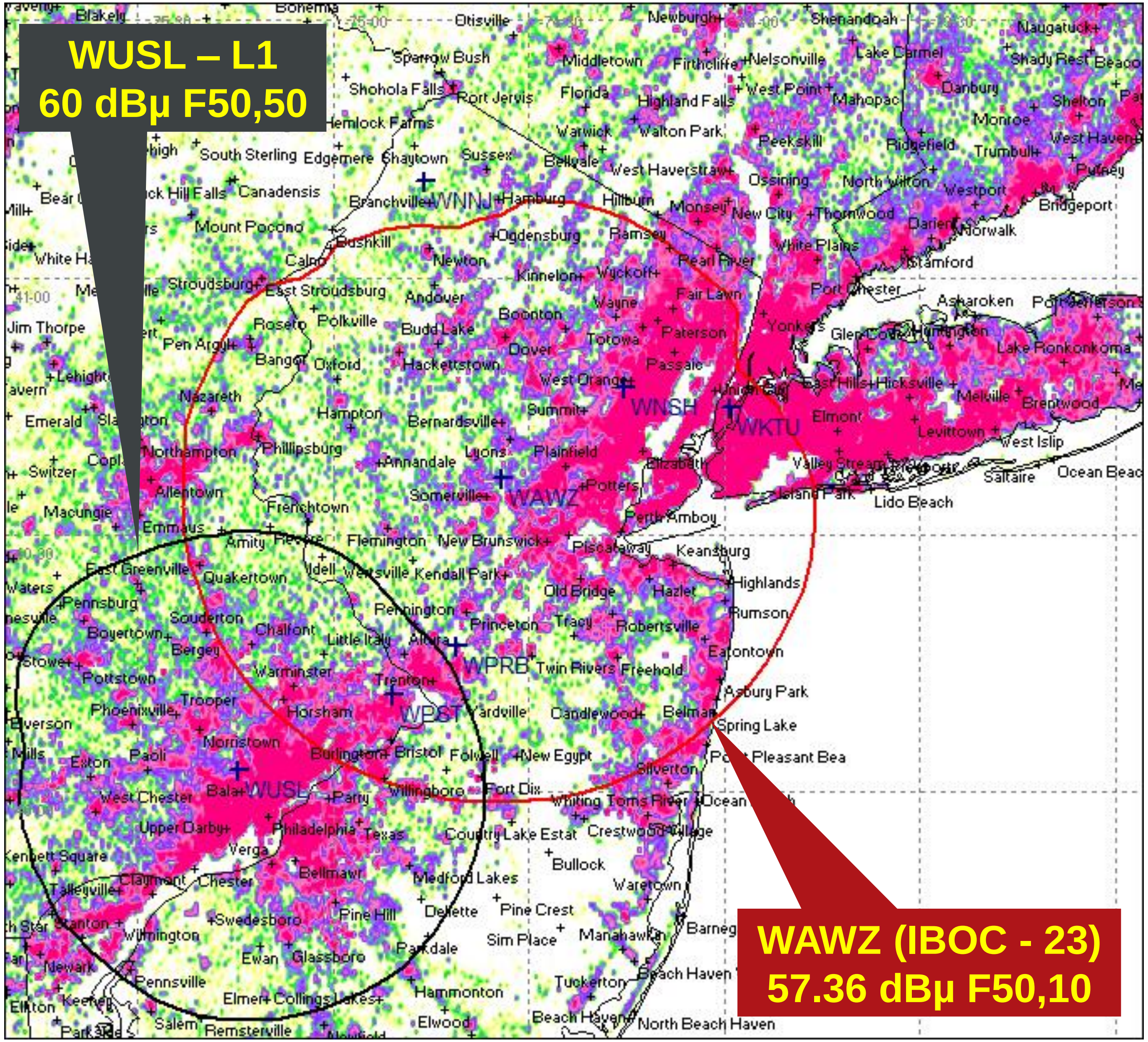
WAWZ (NYC)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -23 dBc / Sideband

WAWZ's IBOC F50,10 interfering contour is plotted at 57.3656 dBu

WUSL (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **38.9** dB above the 57.3656 dBu level set for -23 dBc



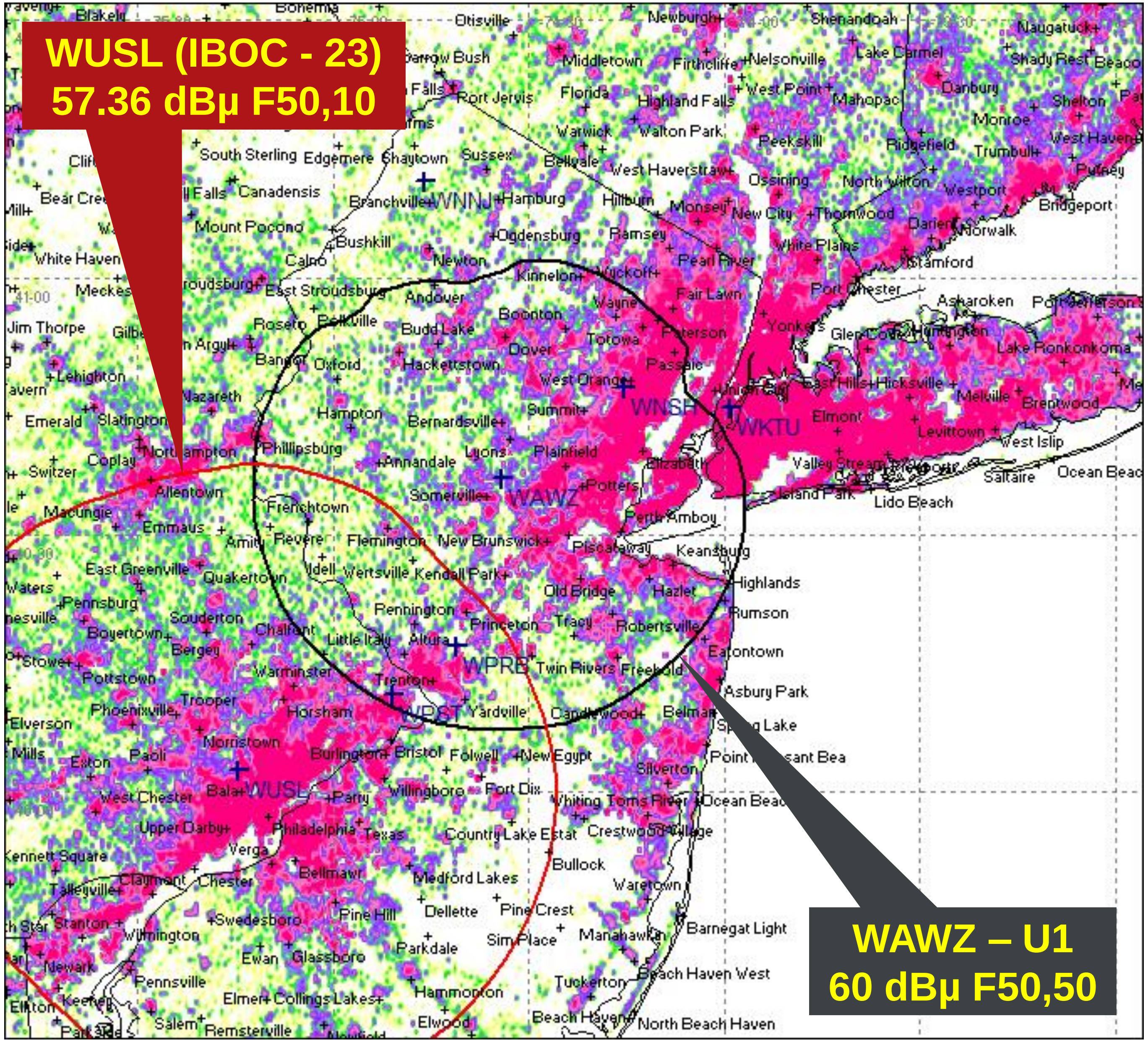
WUSL (NYC)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -23 dBc / Sideband

WUSL's IBOC F50,10 interfering contour is plotted at 57.3656 dBu

WAWZ (Upper 1st) @ its 60 dBu (F50,50) receives IBOC interference **39** dB above the 57.3656 dBu level set for -23 dBc



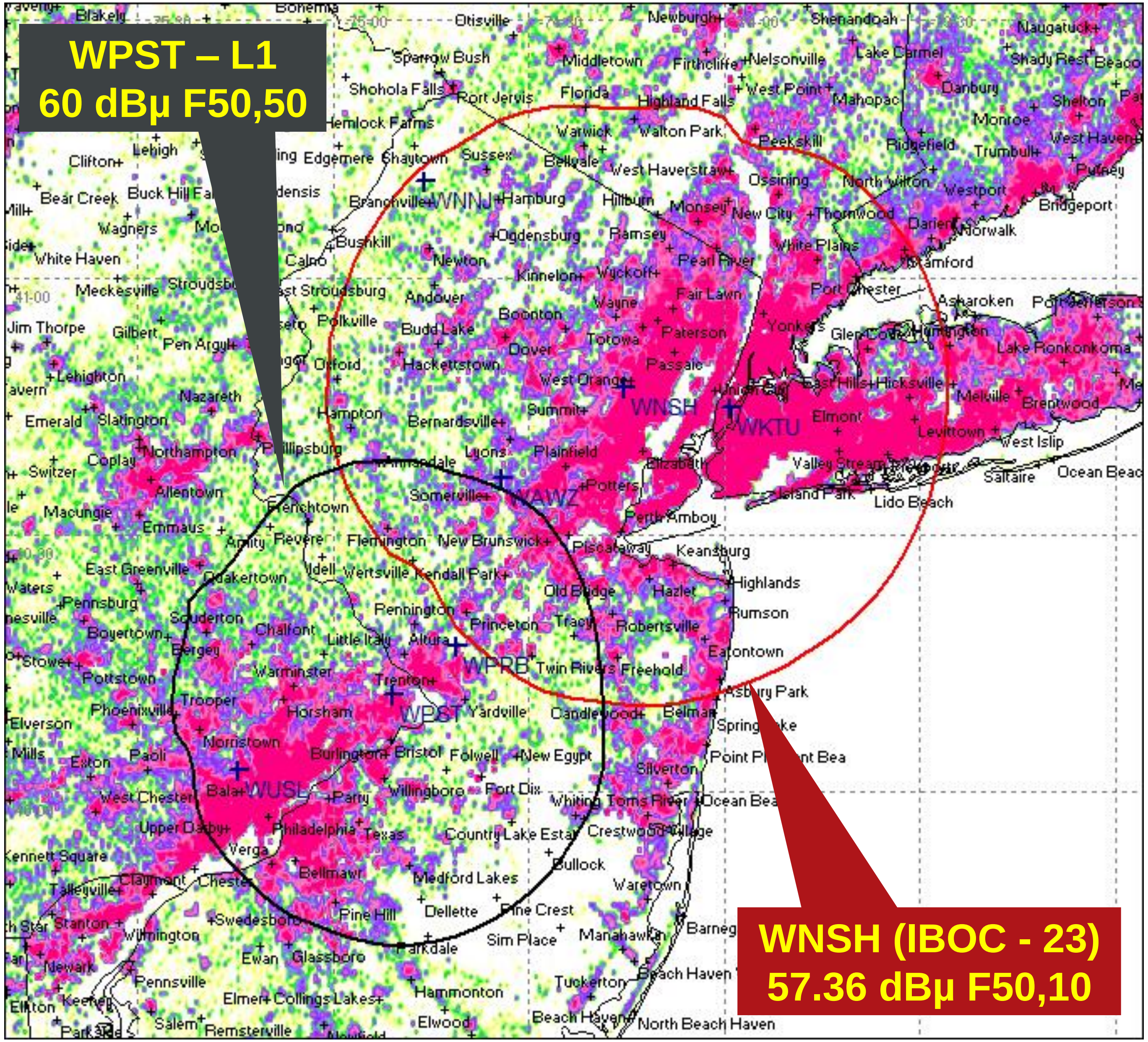
WNSH (NYC)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -23 dBc / Sideband

WNSH's IBOC F50,10 interfering contour is plotted at 57.3656 dBu

WPST (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference **35.8** dB above the 57.3656 dBu level set for -23 dBc



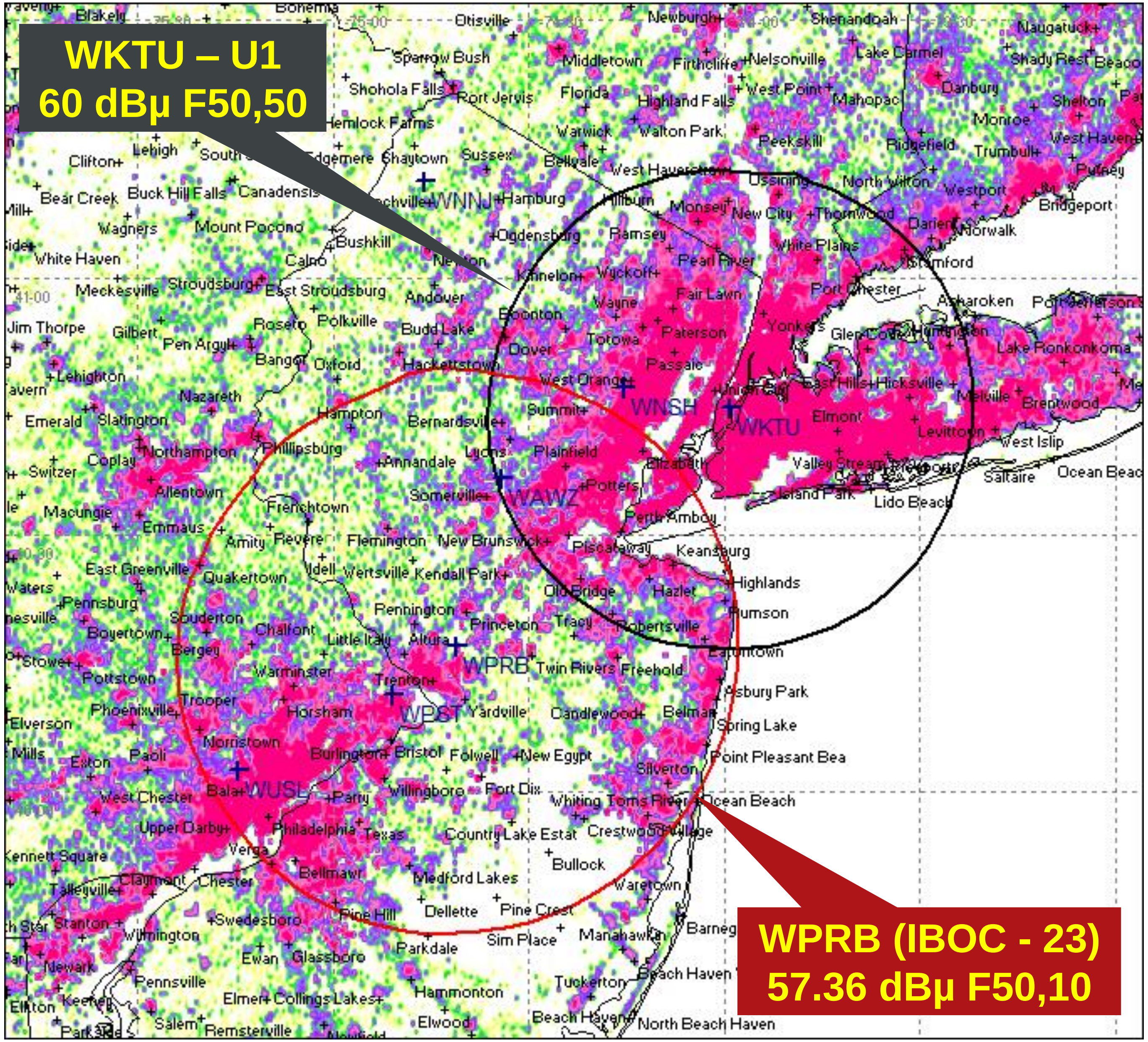
WPRB (NYC)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -23 dBc / Sideband

WPRB's IBOC F50,10 interfering contour is plotted at 57.3656 dBu

WKTU (Upper 1st) @ its 60 dBu (F50,50) receives IBOC interference ***45.1 dB*** above the 57.3656 dBu level set for -23 dBc



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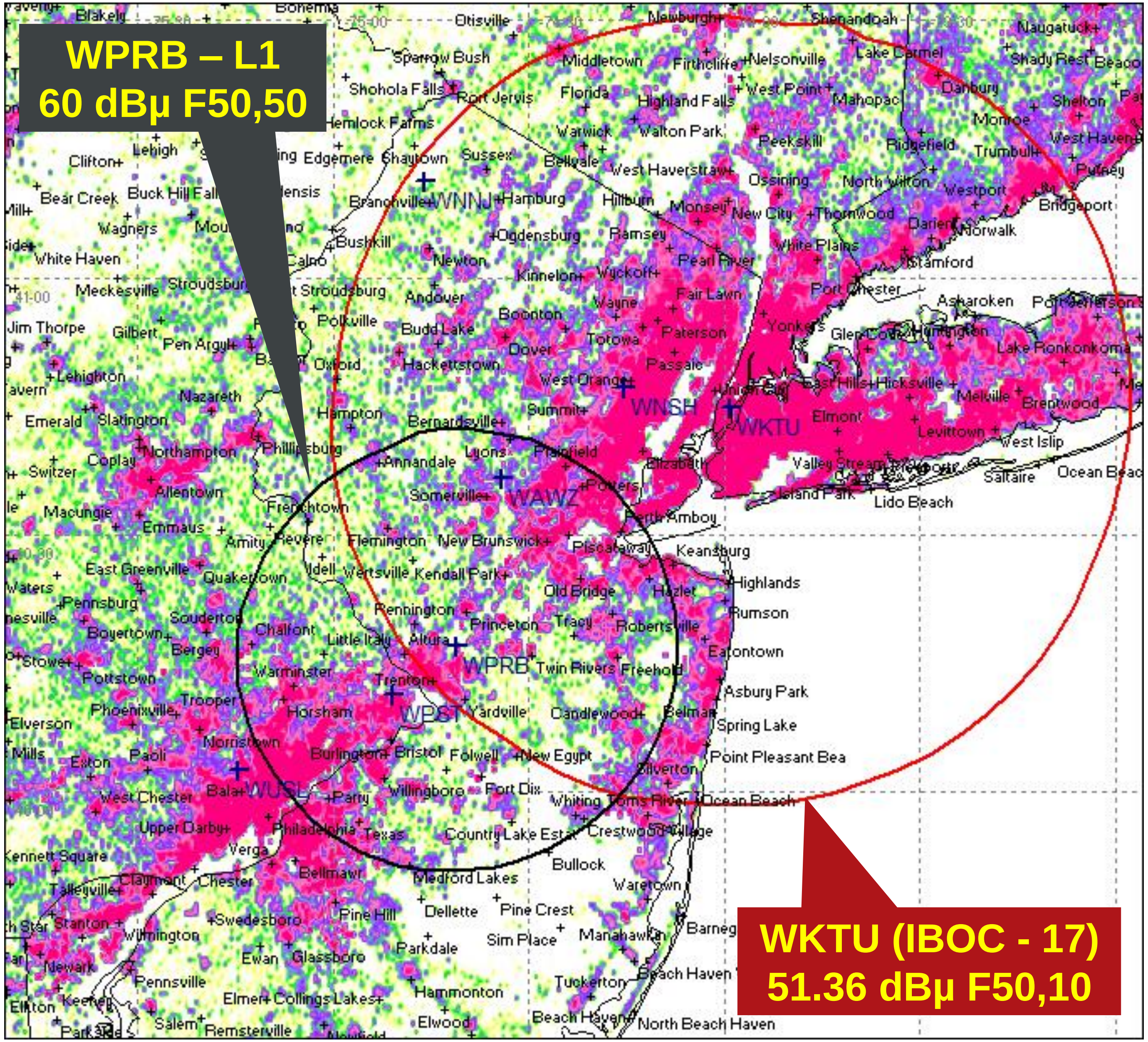
WKTU (NYC)

Physical Short Spacing

Is transmitting with HD Radio™ technology at a digital power level of -17 dBc / Sideband

WKTU's IBOC F50,10 interfering contour is plotted at 51.3656 dBu

WPRB (Lower 1st) @ its 60 dBu (F50,50) receives IBOC interference ***48.7 dB*** above the 51.3656 dBu level set for -17 dBc

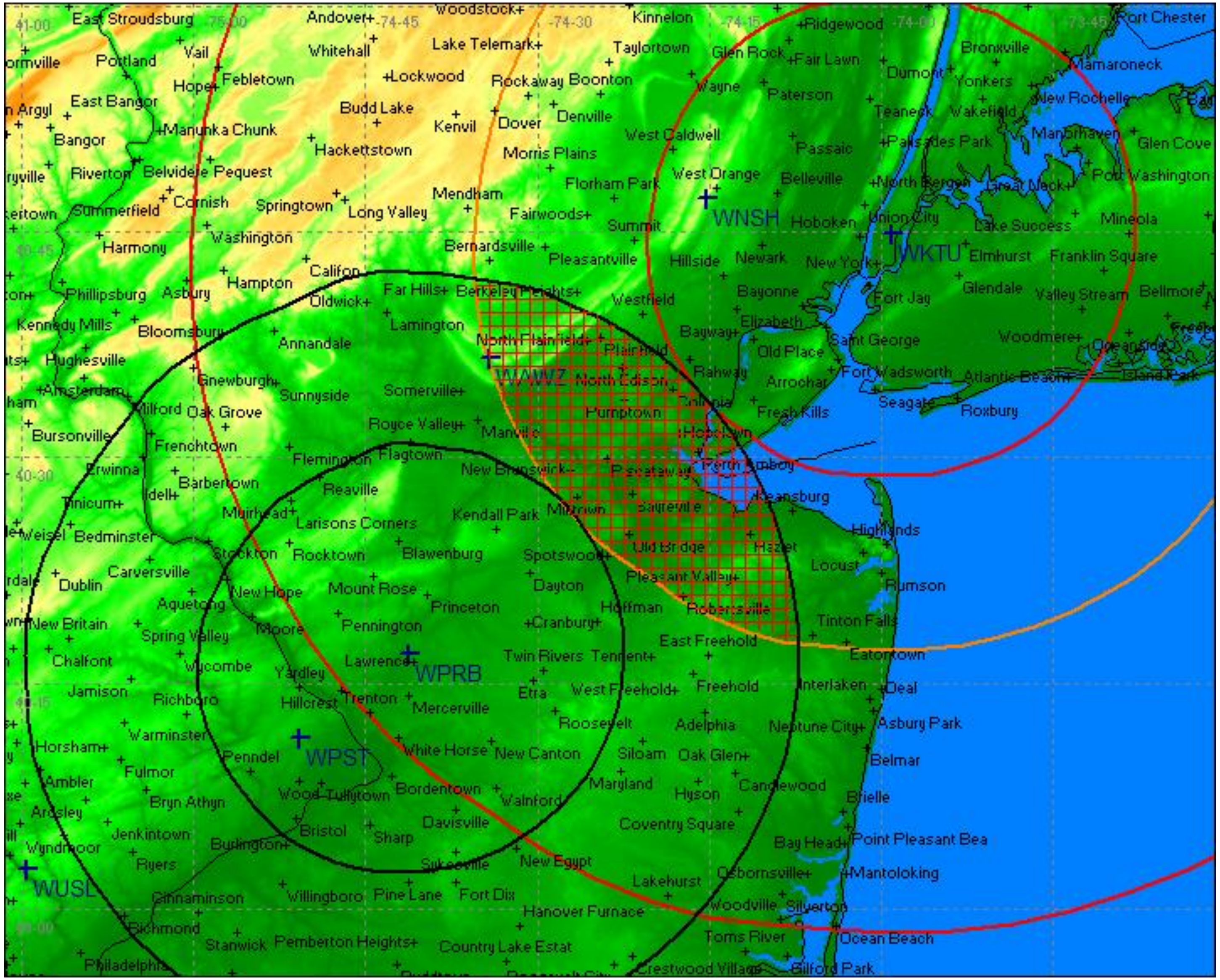


Actual Interference Potential

Short-Spaced Station's potential interference point is determined by the <u>Desired to Undesired Ratio</u> and <u>*NOT*</u> the absolute level of the interferer.

WKTU / WPRB may be one of the worst case interference scenarios East of the Mississippi) The digital interference (>40dB) that these stations mutually generate is not as severe as it appears. The actual interference only extends to an 8.6 dB D/U point at WPRB's 72 dBu contour.

The "eye" shaped area represents the actual interference.



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Legacy FCC Power Increase Formula

The testing supporting the current FCC power increase formula was based primarily on the noise mitigation effects of the 2009 generation of analog receivers.

In the intervening years, the state of the art in analog receiver design has improved to mitigate IBOC interference. One of these improvements is characterized by iBiquity patent # 9,634,704 - "*FM analog demodulator compatible with IBOC signals*" which includes IBOC interference in its stereo/mono blend decisions.

Updated and Legacy Formula

Based on studies of New York City to Philadelphia interference profiles, Xperi proposes a simplified, updated formula that calculates allowable IBOC power by subtracting the IBOC station's F50,10 field intensity at the "victim" station's 60 dBu contour from a constant.

The constant "**41**" allows the Empire State Building based NYC / "Roxborough Antenna Farm" Philly Stations to operate at a full -10 dBc (total power).

IBOC Power / Sideband = 41 (Constant) – IBOC F50,10 @ 60 dBu "Analog" F50,50

ie: 41 – 54 (dBu F50,10 IBOC Contour) = -13 dBc / Sideband (-10 dBc Total Power)

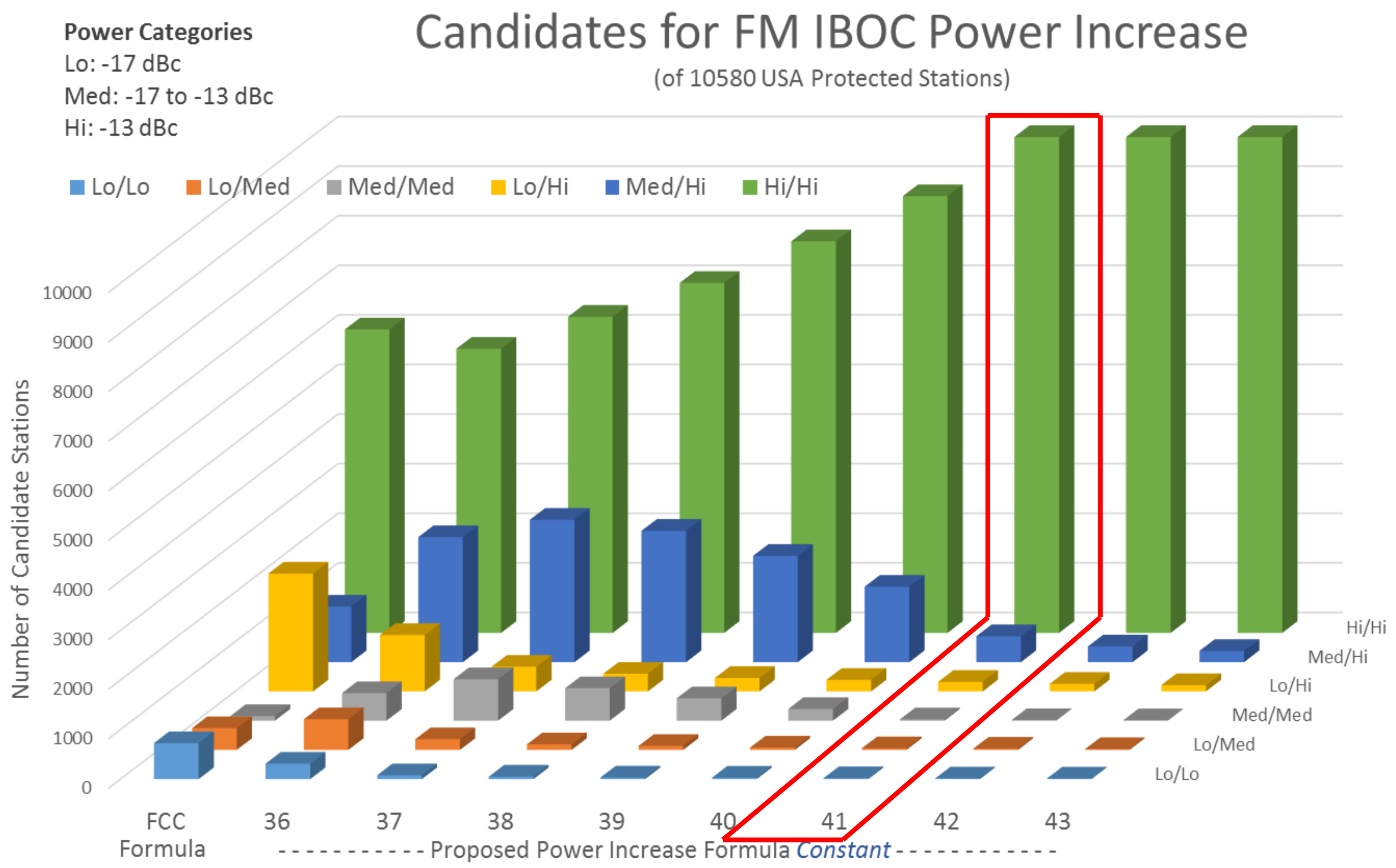
To put it simply:

Properly spaced 1st Adjacent Stations (Defined by the 60 dBu contour)

(Desired = 60 dBu F50,50 / Undesired = 54 dBu F50,50)

May increase their IBOC Power to -13 dBc / Sideband (-10 dBc Total)

Lo Lo	Station may NOT increase either sideband past -17 dBc
Lo Med	Station may increase only one sideband to some value between -17 and -13 dBc. He other must remain at -17 dBc
Med Med	Station may increase both sidebands to some value between -17 and -13 dBc.
Lo Hi	Station may increase only one sideband to -13 dBc. The other remains at -17 dBc.
Med Hi	Station may increase one sideband to -13 dBc. The other to some value between -17 and -13 dBc.
Hi Hi	Station may increase both sidebands to the maximum permitted level of -13 dBc



FCC Formula: IBOC Power / Sideband = (2.27 * (60 - IBOC Station F 50,10 @ First Adjacent 60 dBu F 50,50)) - 36.6

Proposed Formula: IBOC Power / Sideband = (*Constant* - IBOC Station F 50,10 @ First Adjacent 60 dBu F 50,50)

XPERI

AND NOW . . . .

Glynn Walden will present the results of the Philadelphia / New York City noise study that establishes a justification for the proposed, simplified power increase formula

XPERI

Allocation Evaluation for IBOC Power Increase

A Few Slides on IBOC Compatibility

Noise Is An Important Consideration In IBOC Coverage And A Determining Factor In Masking IBOC Interference Into Adjacent Channel Analog Reception

- Early in USADR's development of the IBOC system it was observed that the noise levels in the FM band were higher than just outside of the FM band.
- Out of band transmitter emissions were determined not to be the source of the noise.

The Noise Level is an Inadvertent Result of the FCC's Allocation Process.

- USADR engineers suspected that the noise in the FM Band was the result of the summation of a finite number of co-channel stations.
  - The summation of a finite number of asynchronous co-channel stations manifests itself as nearly white, Gaussian noise.
- In 1998 USADR contracted with the consulting firm of Moffett Larson and Johnson to study the issue and later in 2000 iBiquity contracted with Hammett and Edison to taker a deeper look into the numbers.
- 20 Channels were studied
  - The noise levels differs by channel due to the number of allocated stations the H & E study used Longley-Rice modeling to study a representative sampling of channels including the Reserved band Channels 203, 214, 216, and 218, the former Class A Channels 232, 280, 285, and 288, and the former Class B/C Channels 222, 229, 239, 241, 253, 260, 264, 273, 281, 294, 297, and 300.
- Both reports concluded that the average noise level in the FM band was equivalent to 20 dBu

The H&E Report Was Submitted to the NRSC

iBIQUITY DIGITAL

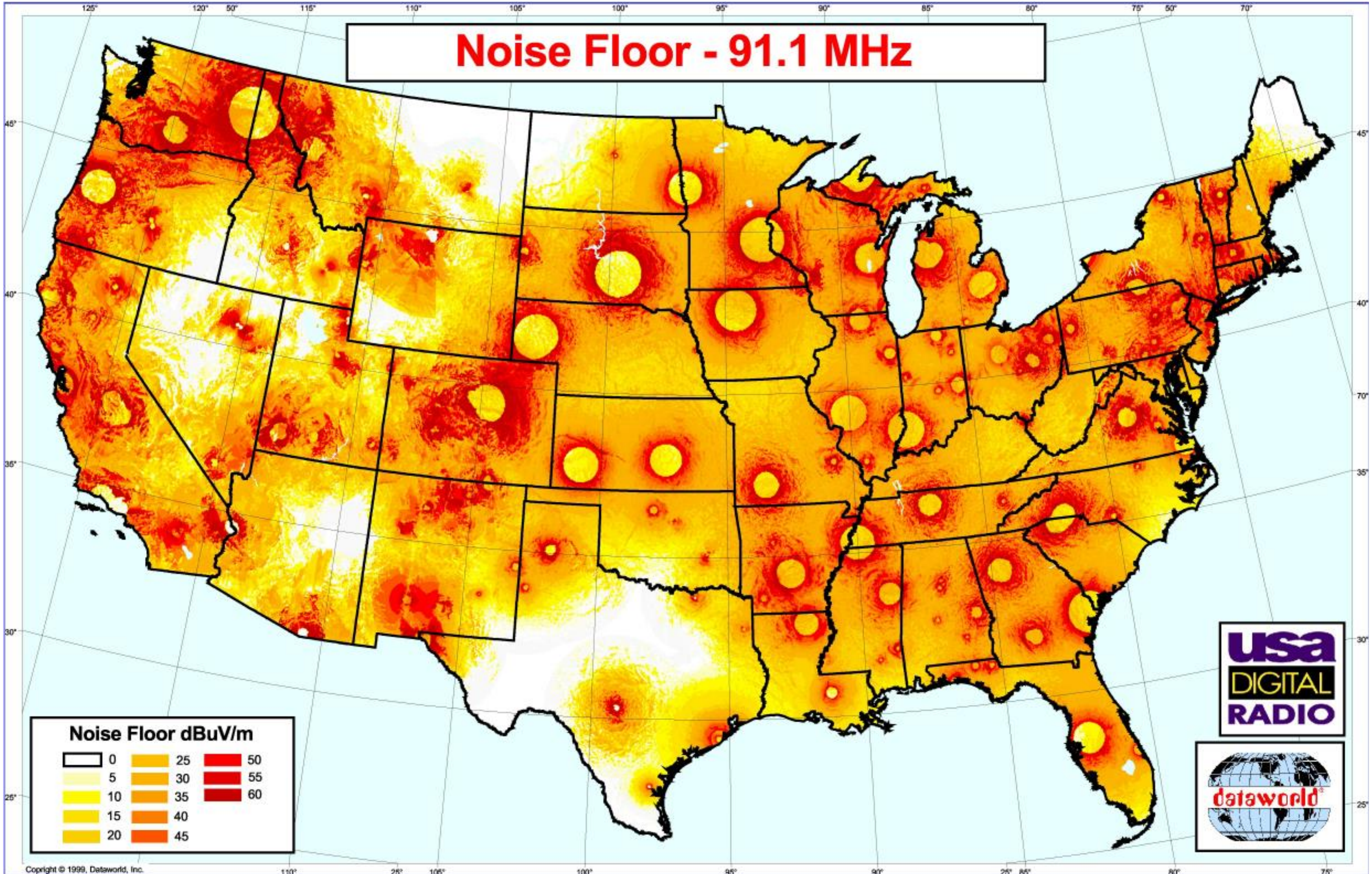
NRSC Noise Report

November 2001

iBiquity Digital Corporation

8865 Stanford Boulevard, Suite 202
Columbia, Maryland 21045
(410) 872-1530

20 Independence Boulevard
Warren, New Jersey 07059
(908) 580-7000



Noise Floor - 91.1 MHz
Noise Floor dBuV/m
0
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10
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45
50
55
60
usa
DIGITAL
RADIO
dataworld
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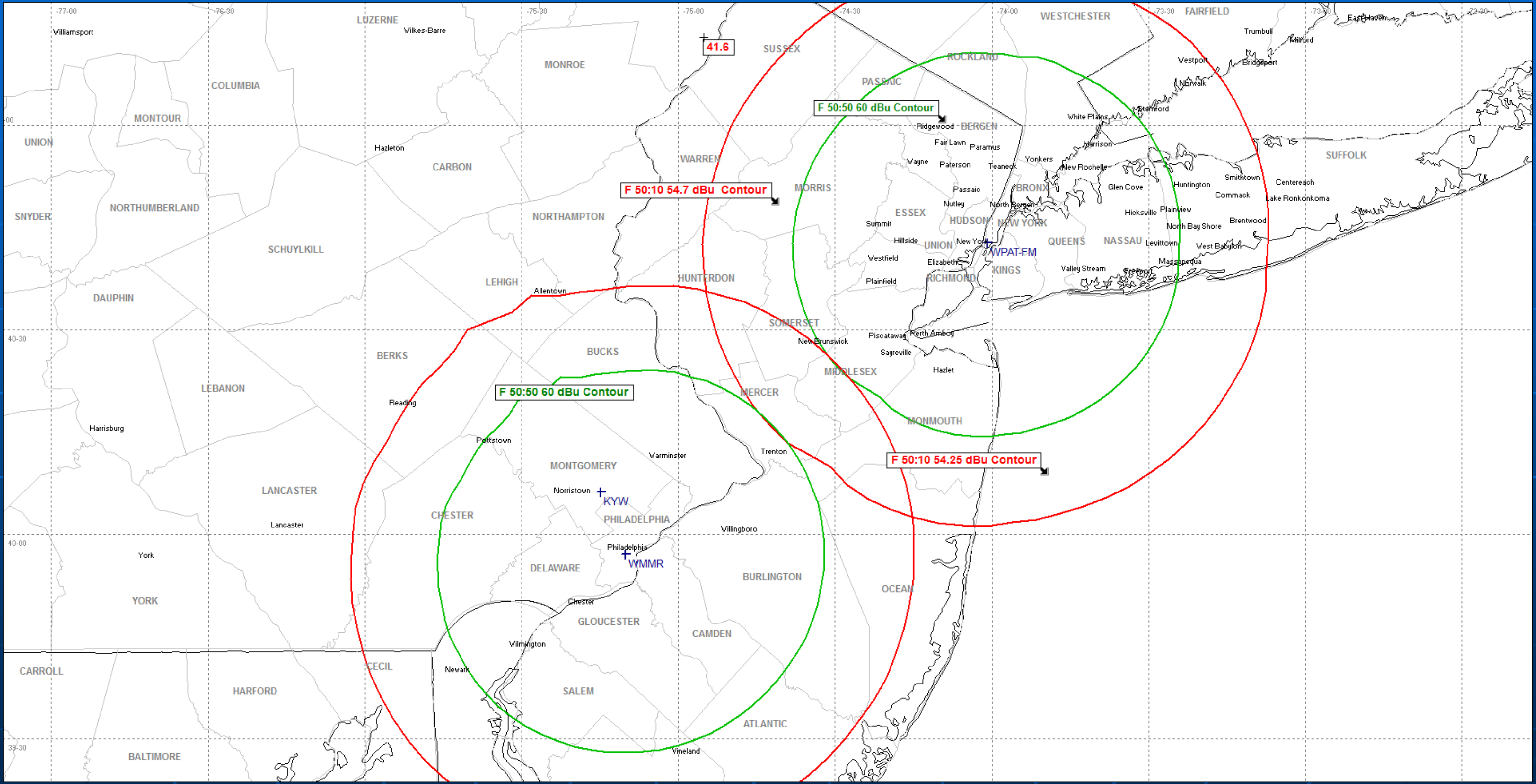
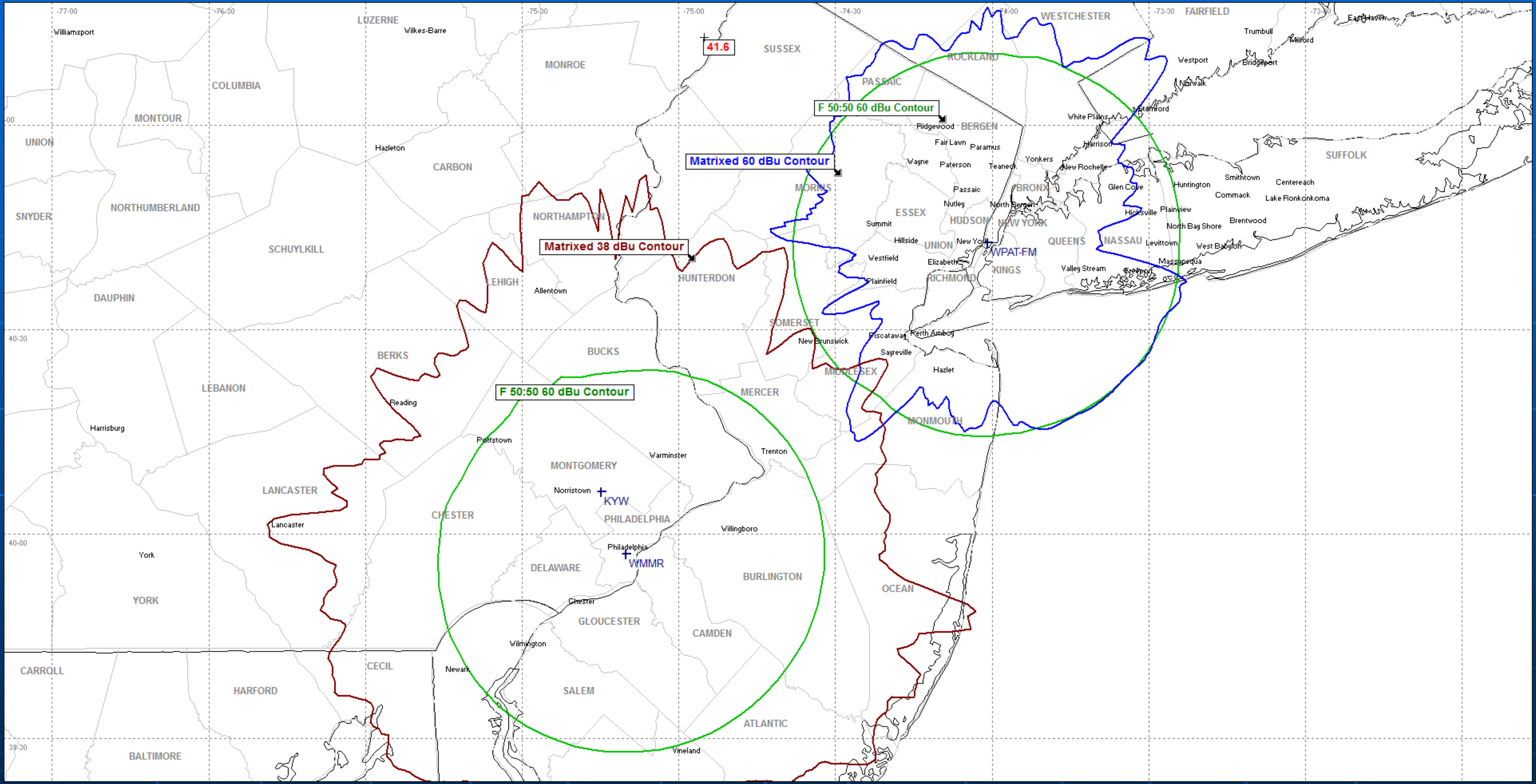
Follows a Case Study of 4 Short Spaced Stations Class B Stations in New York City and Philadelphia

- Most New York signals come from the Empire State building
  - Transmitting from the same master antenna
  - With identical ERPs.
- The Philly stations are co-located in the Philadelphia Antenna Farm.
- All are full Class B facilities (adjusted for height. One of these pairs were included in the iBiquity, CBS, Clear Channel and Greater Media, high power testing program of 2007
- The New York and Philly stations are 80%.of proper spacing

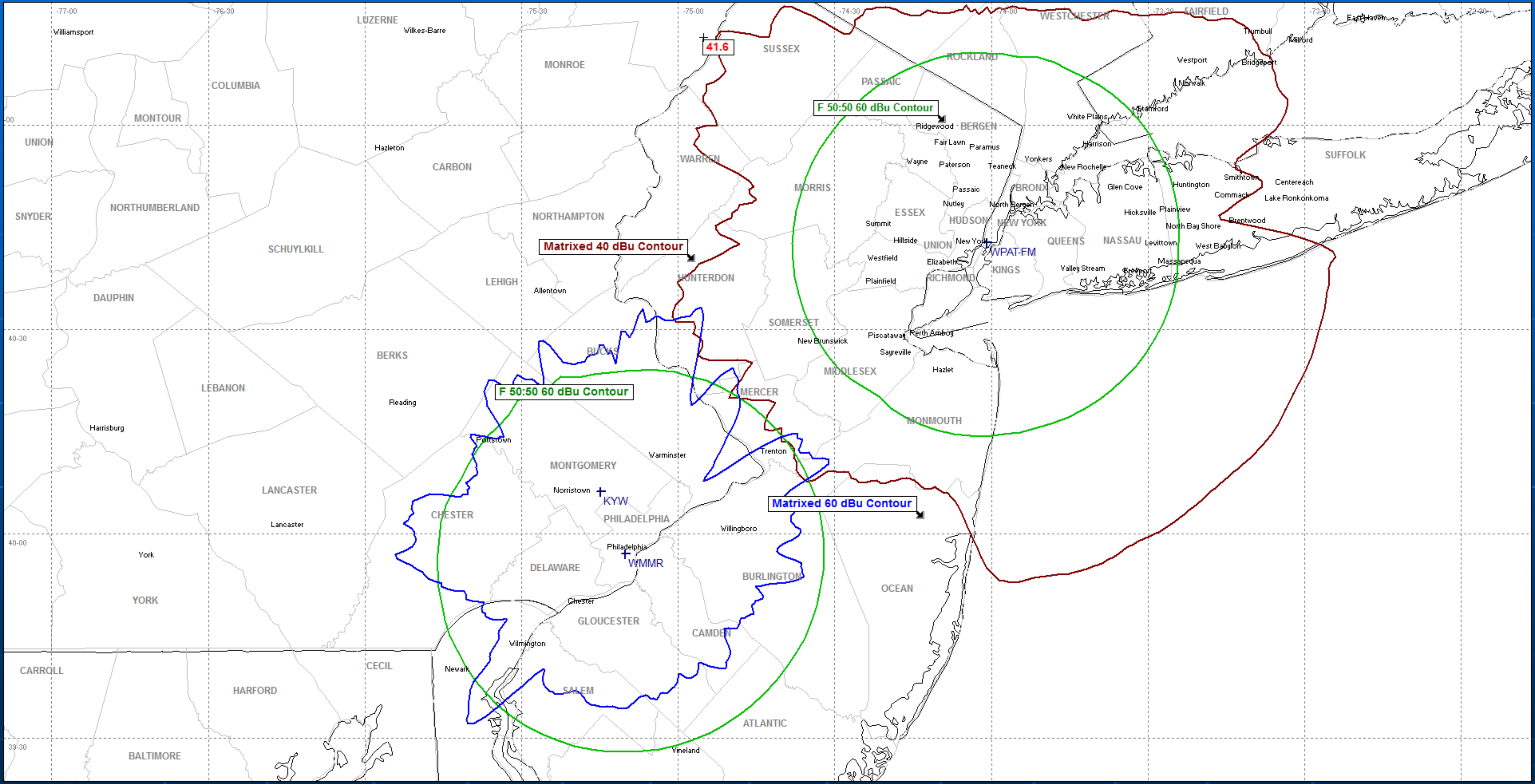
WPAT and WMMR FCC 50:10 Contours at FCC F 50:50 60 dBu Contours



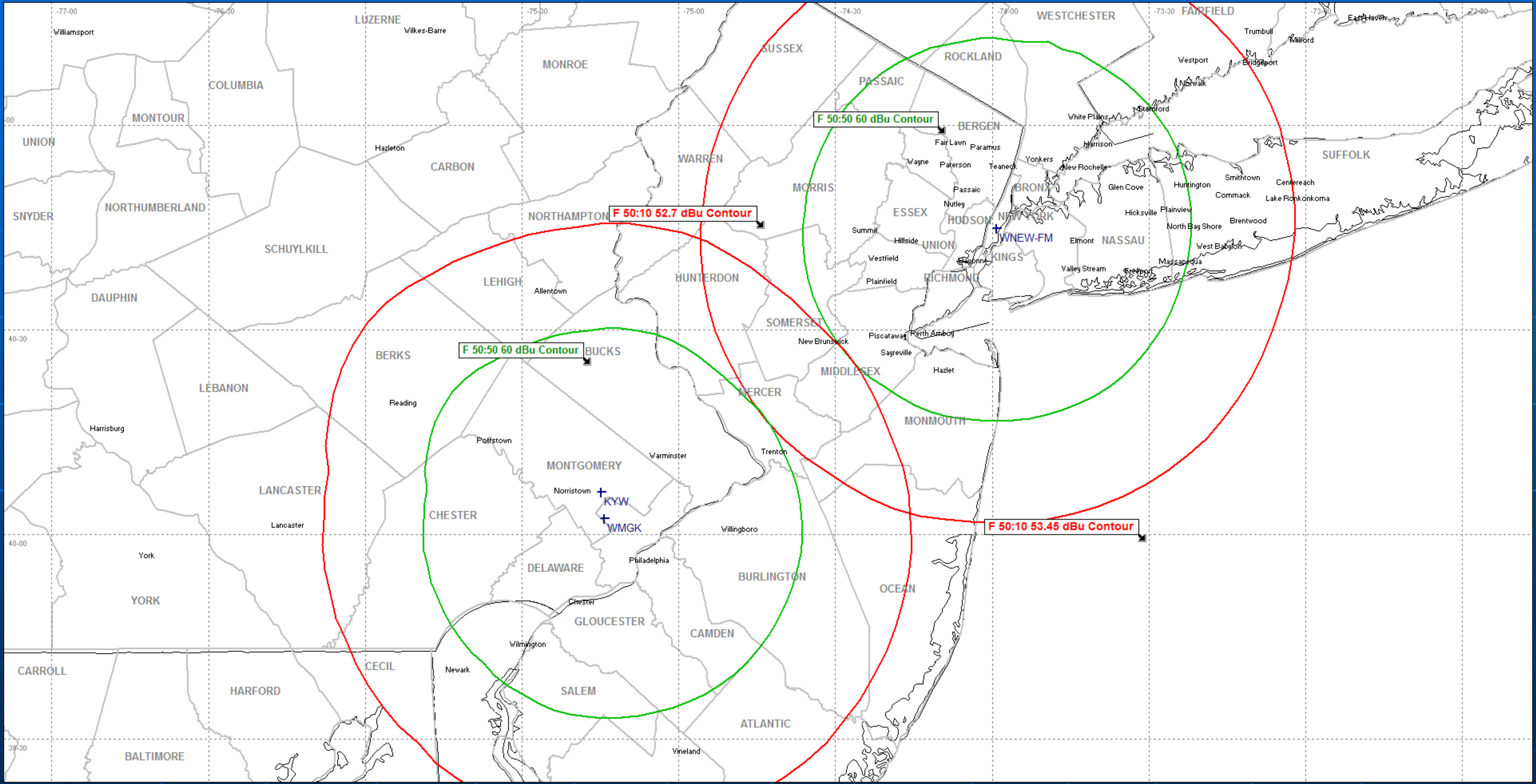
WMMR Matrixed 38 dBu Contour and WPAT Matrixed 60 dBu Contour



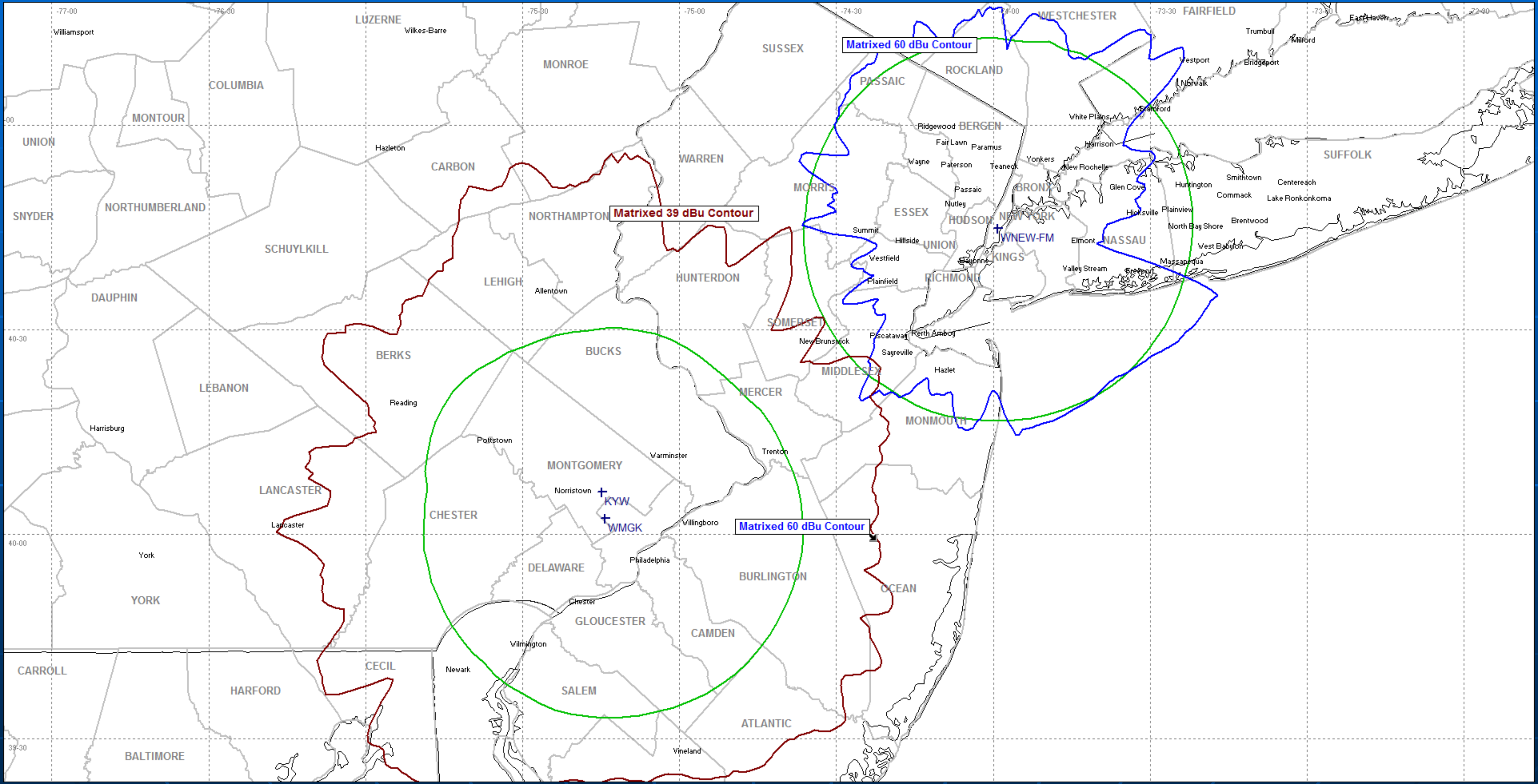
WPAT Matrixed 40 dBu Contour and WMMR Matrixed 60 dBu Contour



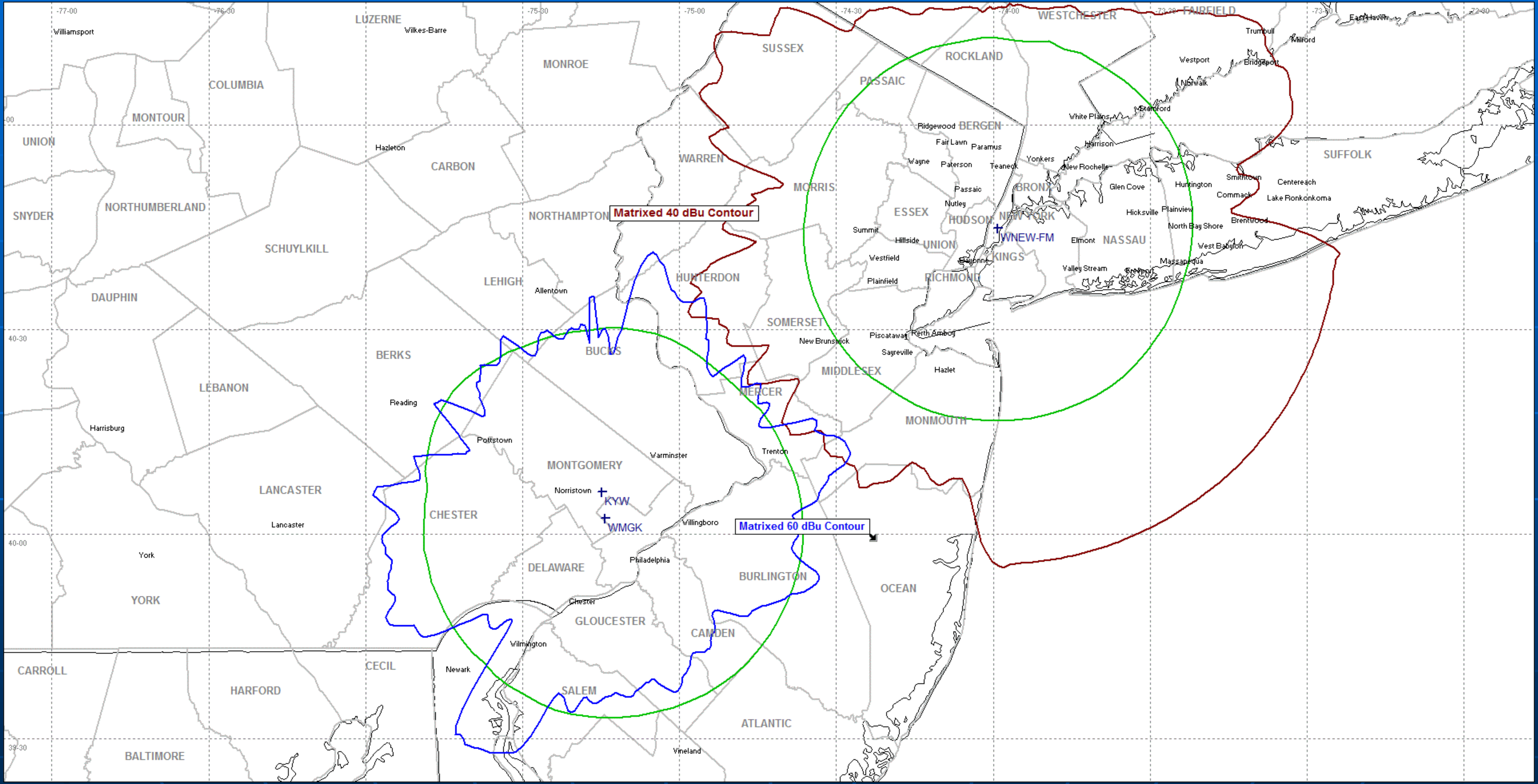
WNEW and WMGK FCC 50:10 Contours at FCC F 50:50 60 dBu Contours



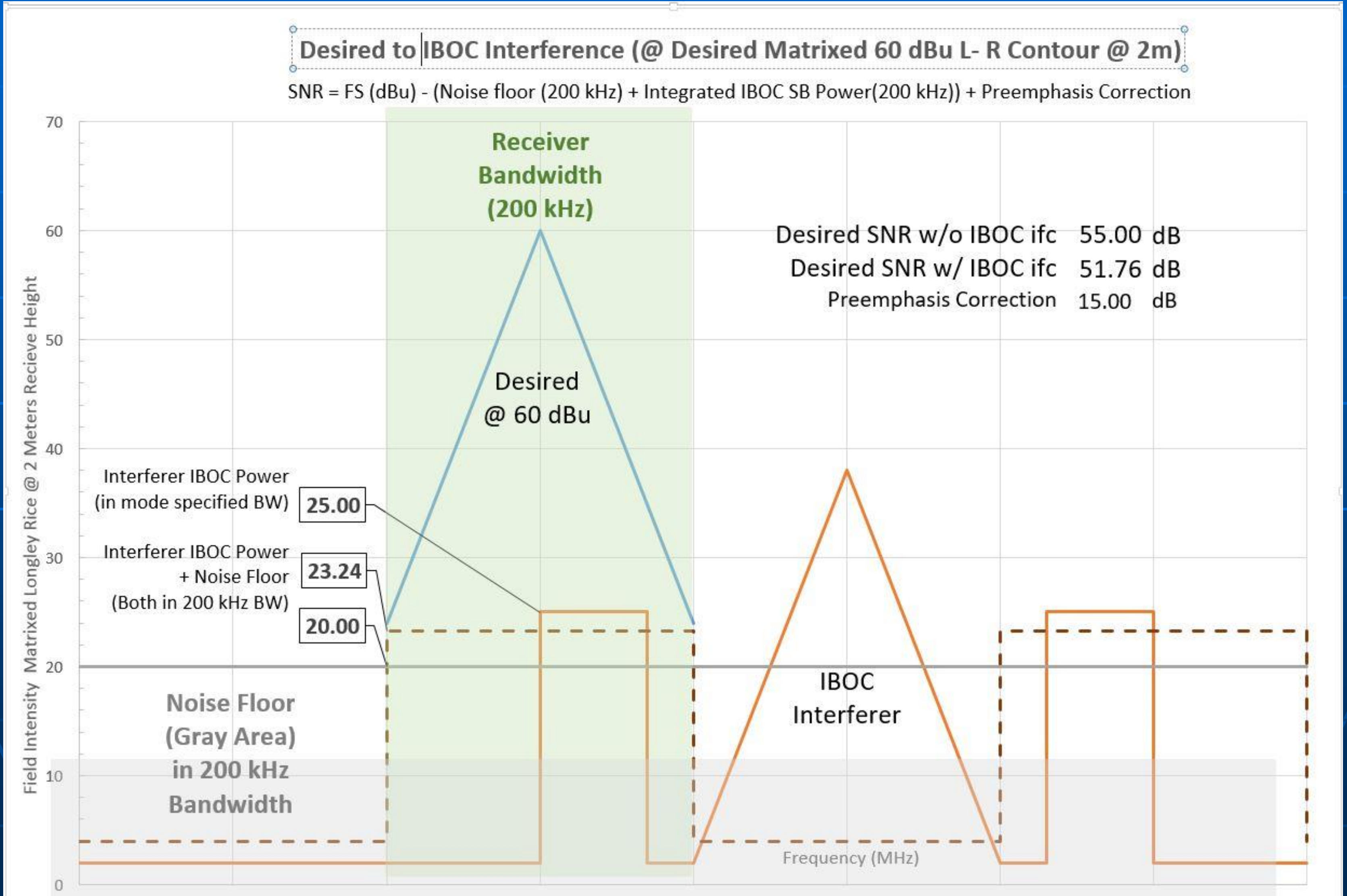
WNEW Matrixed 60 dBu Contour and WMGK Matrixed 39 dBu Contour



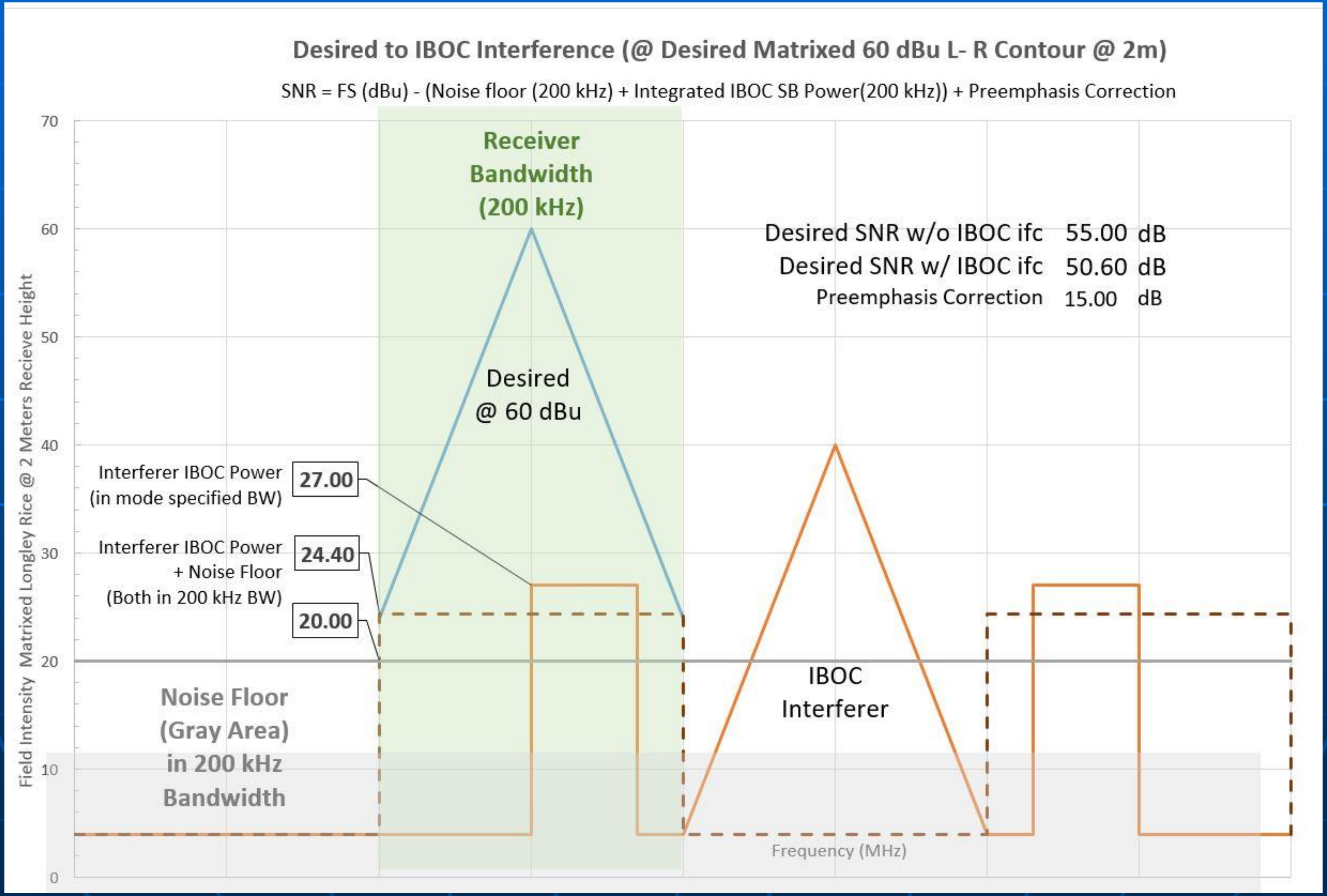
WNEW Matrixed 40 dBu Contour and WMGK Matrixed 60 dBu Contour



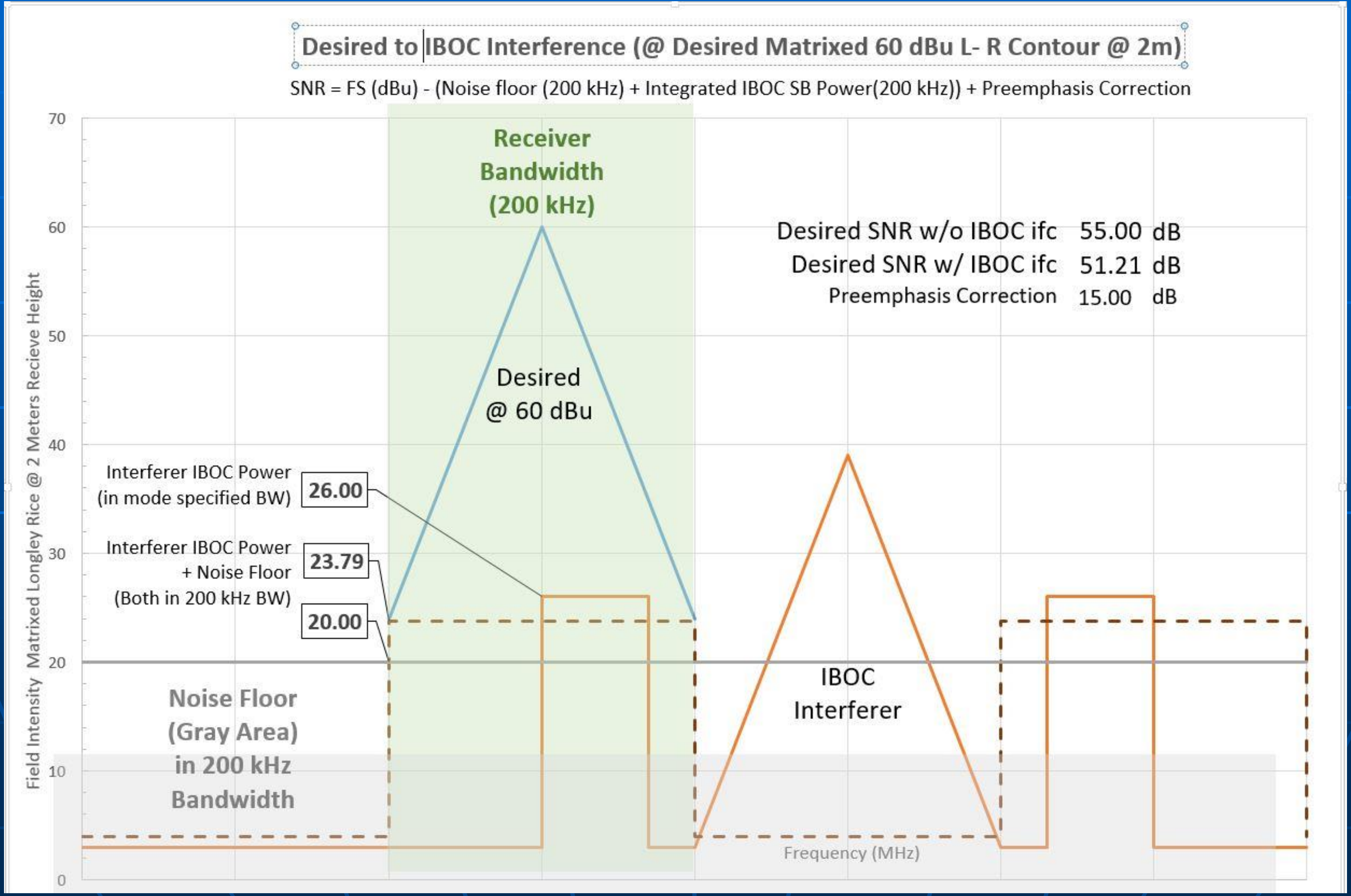
WPAT Analog SNR @ Longley Rice Matrixed 60 dBu Contour & WMMR Longley Rice Matrixed 38 dBu Contour



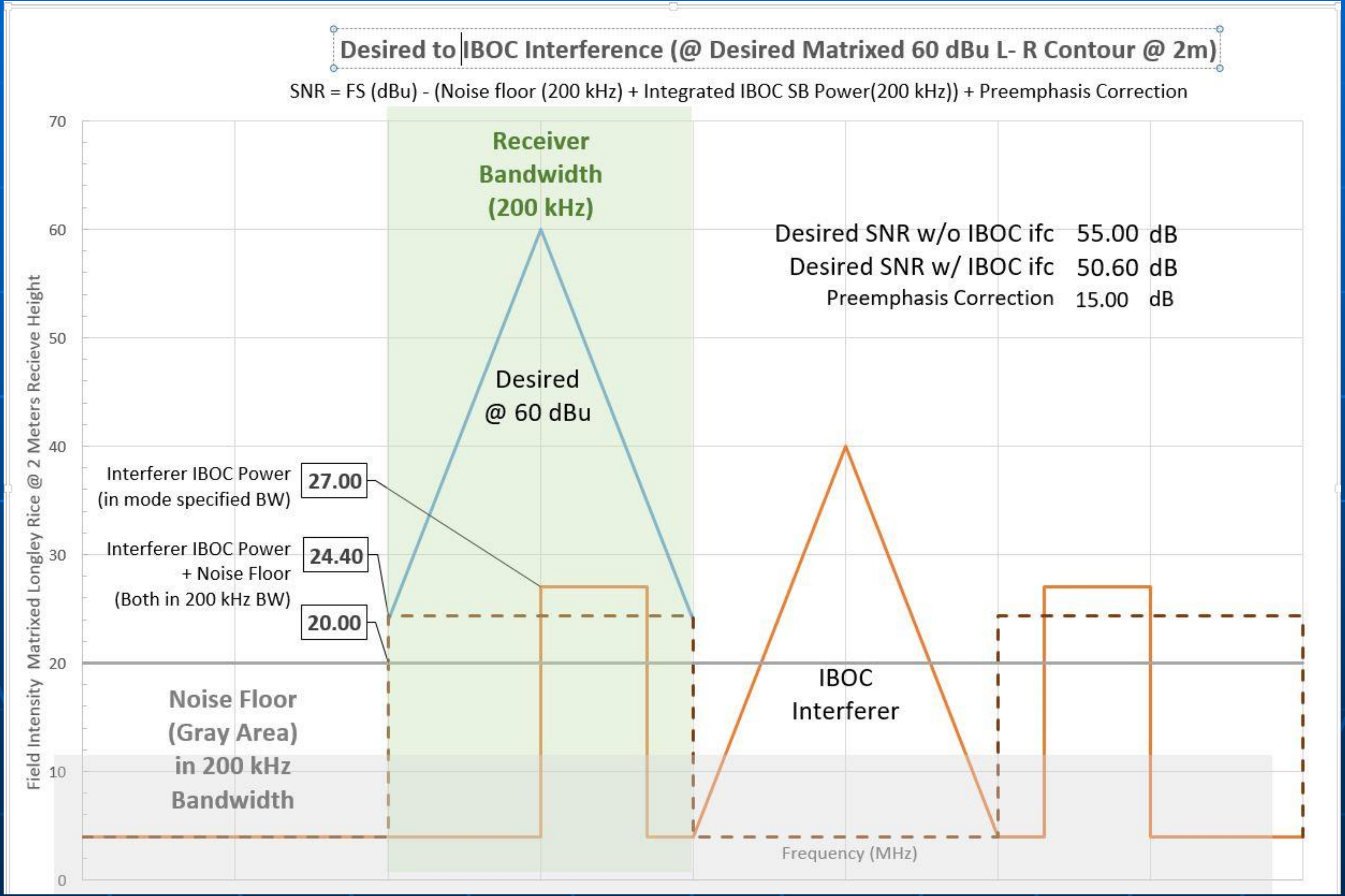
WMMR Analog SNR @ Longley Rice Matrixed 60 dBu Contour & WPAT Longley Rice Matrixed 40 dBu Contour

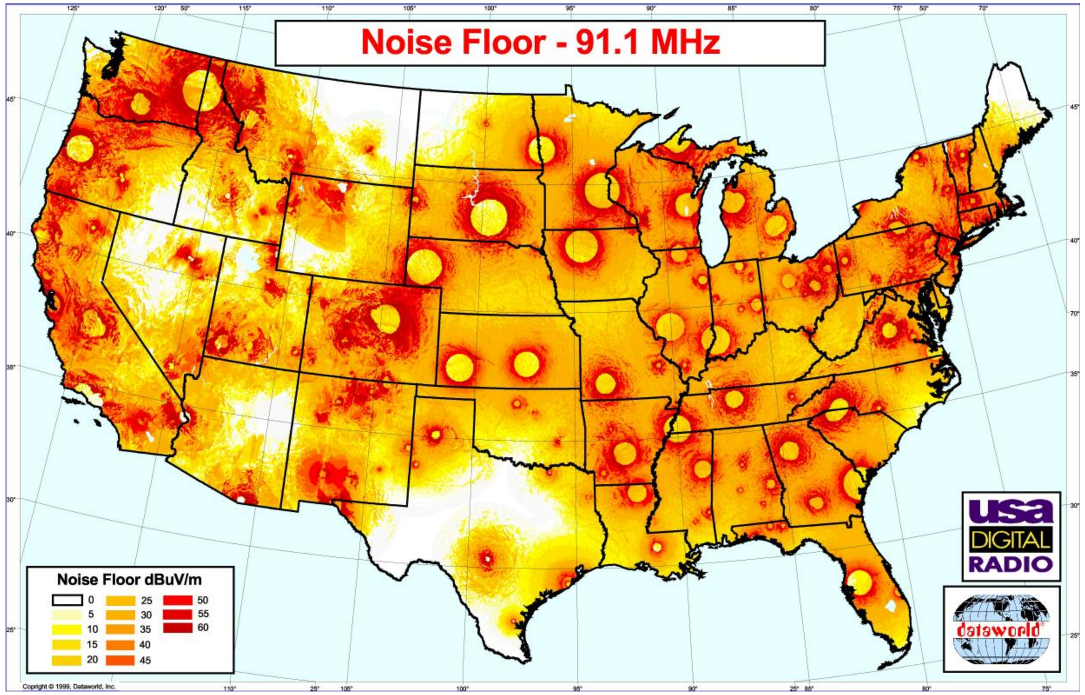


WNEW Analog SNR @ Longley Rice Matrixed 60 dBu Contour & WMGK Longley Rice Matrixed 39 dBu Contour



WMGK Analog SNR @ Longley Rice Matrixed 60 dBu Contour & WNEW Longley Rice Matrixed 40 dBu Contour




Noise Floor - 91.1 MHz
Noise Floor dBuV/m
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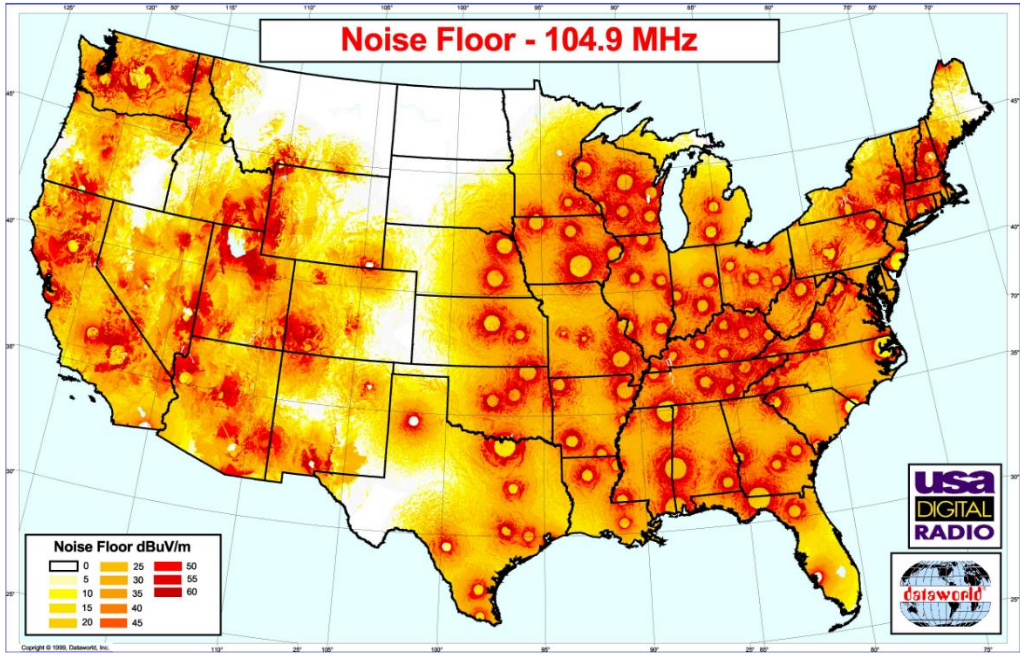
Noise Floor - 104.9 MHz
Noise Floor dBuV/m
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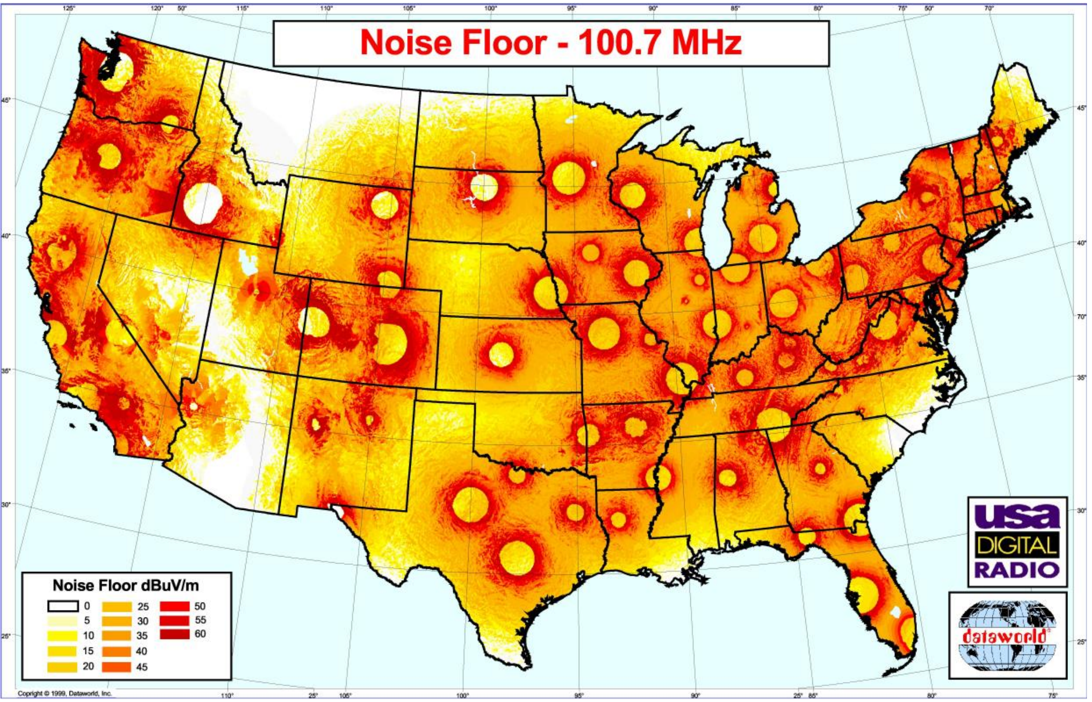
Noise Floor - 100.7 MHz
Noise Floor dBuV/m
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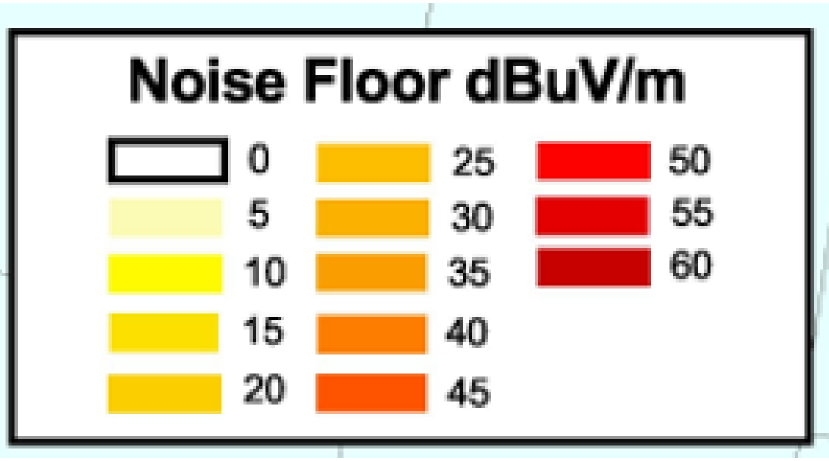
Copyright © 1999, Dataworld, Inc.


Noise Floor dBuV/m
0
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50
55
60

IBOC Compatibility Issue Solved

Received Signal to Noise Ratios				
		IBOC (SSB) Carrier Level		
Noise Floor dBu	Analog	-23 dBc	-17 dBc	-13 dBc
20 dBu	55 dB	54.3	52.7	50.6
25 dBu	50 dB	49.77	49.13	48.08
30 dBu	45 dB	44.92	44.71	44.3

Thank You

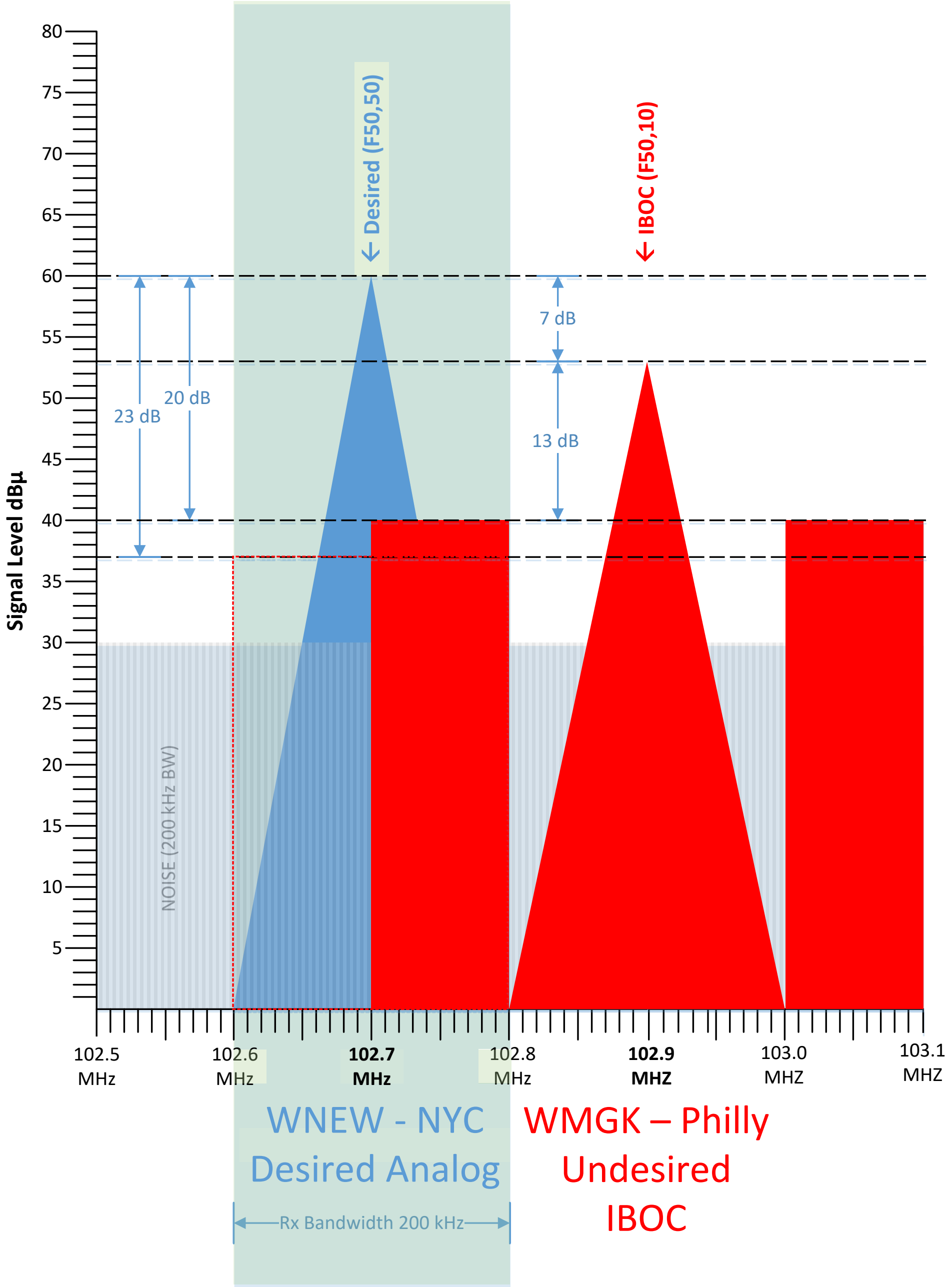
Russ russ.mundschenk@xperi.com
Glynn egwalden@cbs.com

IBOC Compatibility Issue Solved

Received Signal to Noise Ratios				
		IBOC (SSB) Carrier Level		
Noise Floor dBu	Analog	-23 dBc	-17 dBc	-13 dBc
20 dBu	55 dB	54.3	52.7	50.6
25 dBu	50 dB	49.77	49.13	48.08
30 dBu	45 dB	44.92	44.71	44.3

Does This Explain Compatibility?

Received Signal to Noise Ratios				
		IBOC (SSB) Carrier Level		
Noise Floor dBu	**Analog**	**-23 dBc**	**-17 dBc**	**-13 dBc**
20 dBu	**55 dB**	**54.3**	**52.7**	**50.6**
25 dBu	**50 dB**	**49.77**	**49.13**	**48.08**
30 dBu	**45 dB**	**44.92**	**44.71**	**44.3**



Updated Formula Meets USA Co-Channel Protections

(Based on a 60 dBu F50,50 Desired)

If the ***interfering IBOC sideband*** (@ -13 dBc Power) is treated as a ***Co-Channel interferer***, it's total integrated power is **20 dB*** below that of the desired Analog Station's carrier power.

For this NY / Philly pairing. WMGK's 52.68 dBu (Rounded to 53 dBu) F50,10 contour intersects WNEW's 60 dBu F50,50.

The Analog to Analog DU is 60 – 53 = 7 dB

WMGK's IBOC Lower Sideband is at -13 dBc

WMGK's IBOC Lower Sideband is 13 + 7 = 20 dB below WNEW's Analog carrier.

**** 47 CFR § 73.215 (2)***
*The interfering contours, for the purpose of this section, are defined as follows. For co-channel stations, the F(50,10) field strength along the interfering contour is **20 dB** lower than the F(50,50) field strength along the protected contour for which overlap is prohibited.*

Note: It is acknowledged that for this comparison, 60 dBu is used across the board for all classes of stations

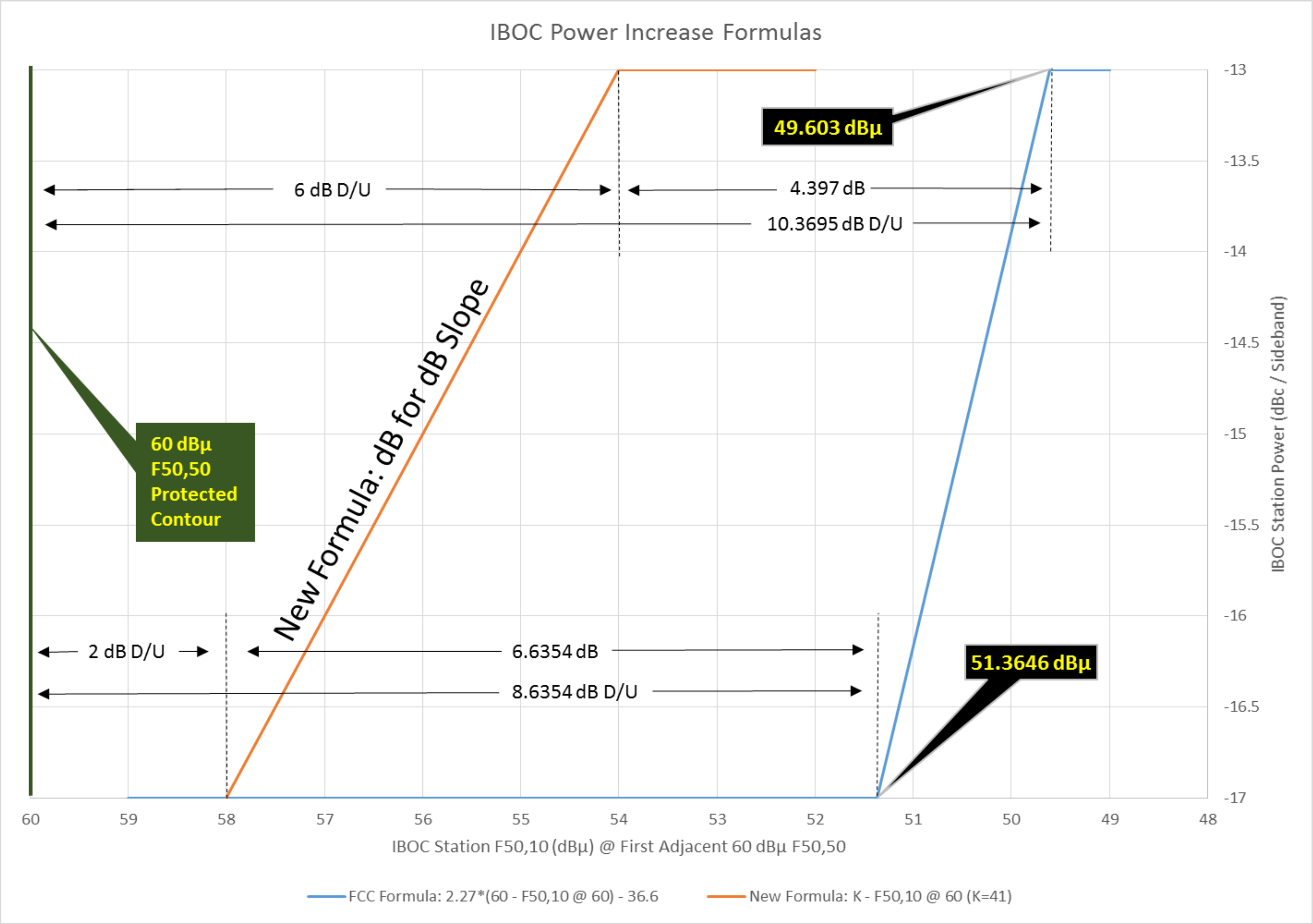
Updated Power Increase Formula

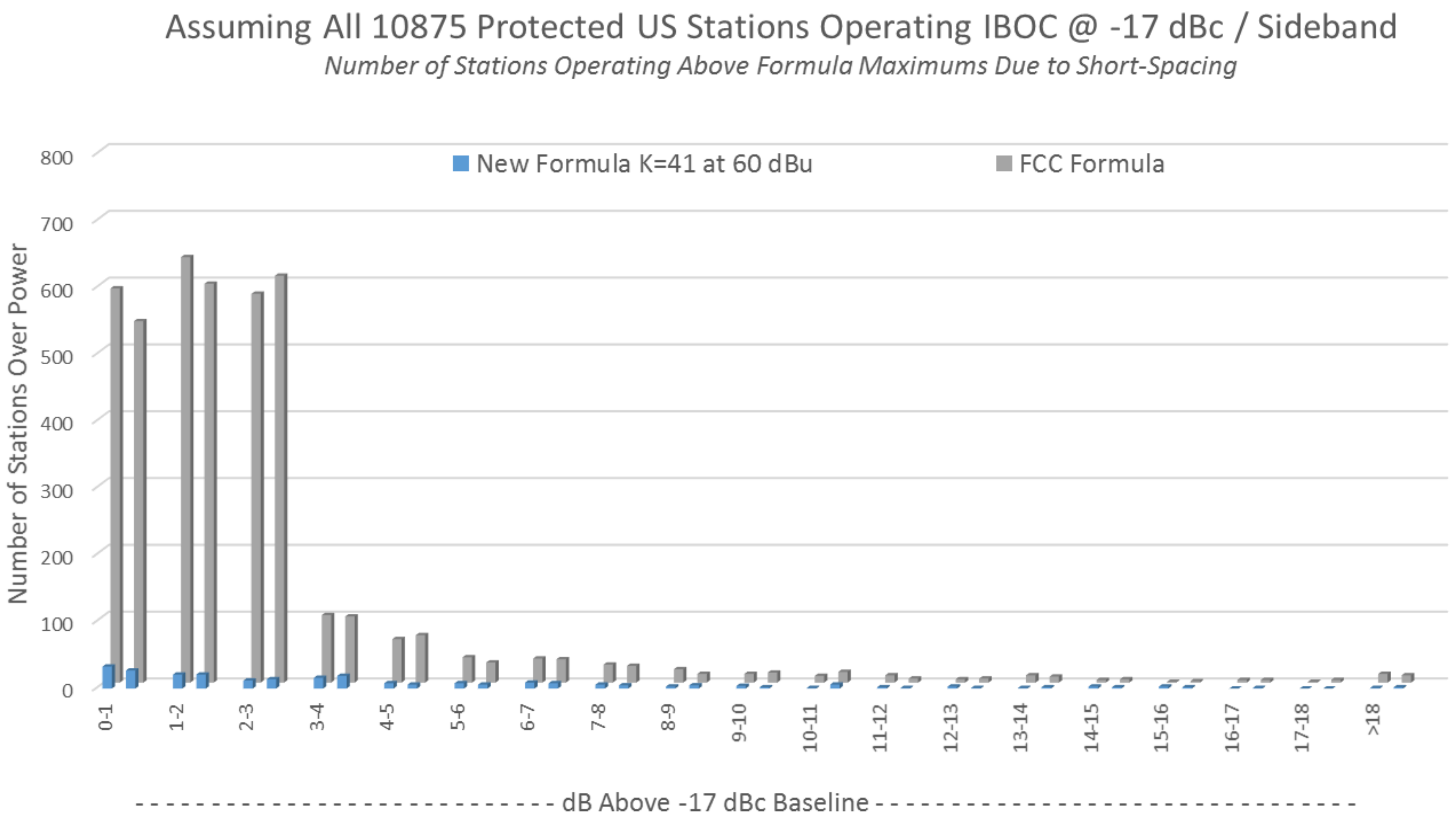
The current power increase formula (per sideband):

- 2.27 X (60 – F50,10 contour field intensity) – 36.6

Would change to:

- 41 - (F50,10 contour field intensity)



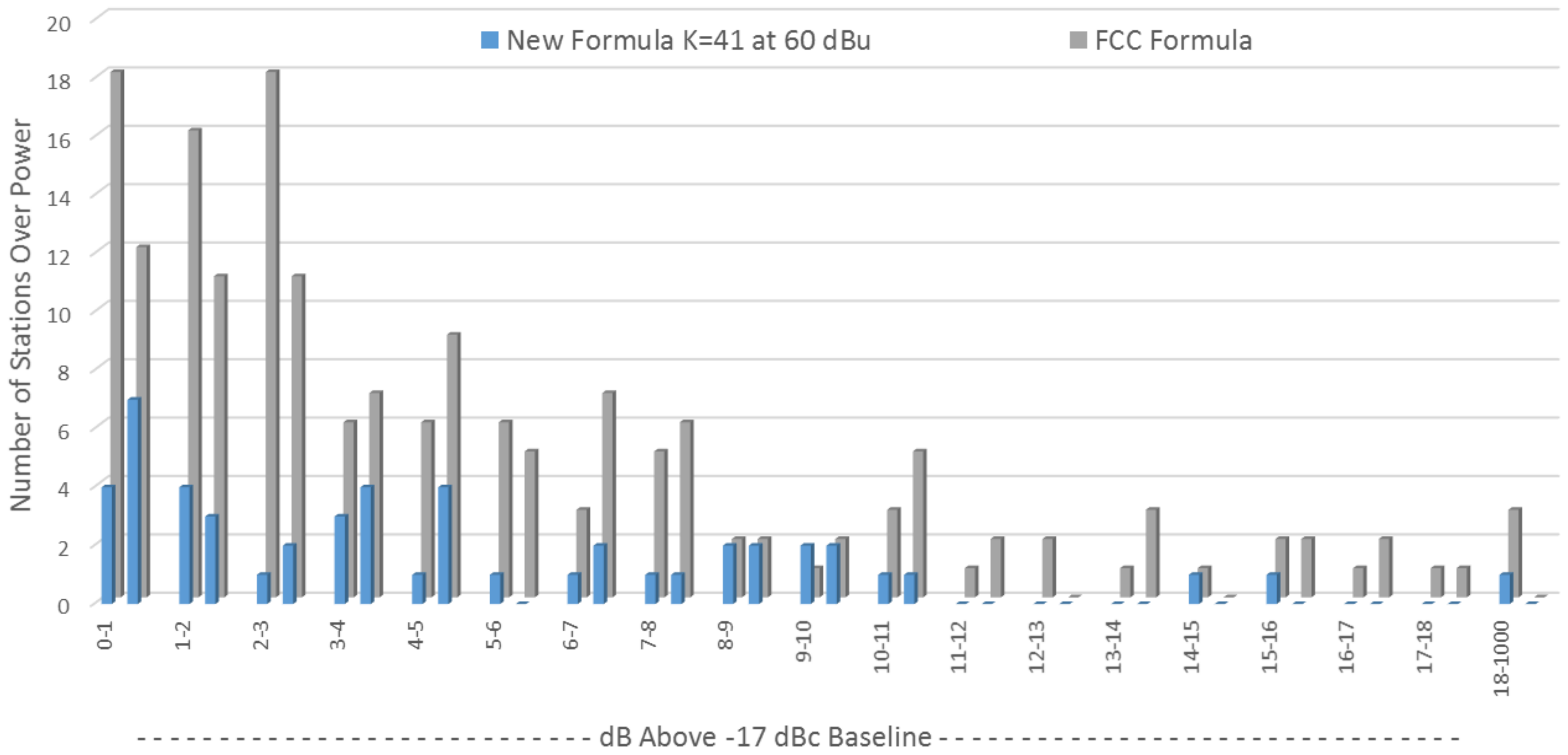


FCC Formula: IBOC Power / Sideband = (2.27 * (60 - IBOC Station F 50,10 @ First Adjacent 60 dBu F 50,50)) - 36.6

Proposed Formula : IBOC Power / Sideband = (41 - IBOC Station F 50,10 @ First Adjacent 60 dBu F 50,50)

All USA IBOC Stations at Current IBOC Power

Number of Stations Operating Above Formula Maximums Due to Short-Spacing



FCC Formula: IBOC Power / Sideband = (2.27 * (60 - IBOC Station F 50,10 @ First Adjacent 60 dBu F 50,50)) - 36.6

Proposed Formula : IBOC Power / Sideband = (41 - IBOC Station F 50,10 @ First Adjacent <u>**60 dBu**</u> F 50,50)

APPENDIX 2

Letter from Audacy to FCC dated July 22, 2021, including Technical Report:

High-power FM Field Test Project – Stations WZMX and WIP

Audacy

2400 MARKET STREET, 4TH FLOOR
PHILADELPHIA, PA 19103

July 22, 2021

***via* EMAIL**
Federal Communications Commission
Office of the Secretary
45 L Street NE
Washington, DC 20554
Attn: Media Bureau, Audio Division
james.bradshaw@fcc.gov
rodolpho.bonacci@fcc.gov

**Re: Station WZMX(FM), Hartford, CT (Facility ID No. 1900)
and Station WIP-FM, Philadelphia, PA (Facility ID No. 28628)
FCC File Nos. 20210205AAQ and 20210205AAE**

Dear Ms. Dortch:

Audacy License, LLC (formerly known as Entercom License, LLC) ("Licensee")[1], licensee of Stations WZMX(FM), Hartford, CT (Facility ID No. 1900) and WIP-FM, Philadelphia, PA (Facility ID No. 28628) (collectively, the "Stations"), hereby submits the enclosed report detailing the research, experimentation and results of the testing authorized pursuant to the above-referenced experimental authority.

In accordance with the instructions set forth in *Audio Division Announces Procedures Related to Coronavirus*, Public Notice, DA 20-266 (rel. Mar. 13, 2020), Audacy is submitting this report via email.

Questions about the report should be referred to Glynn Walden, Audacy's technical consultant (Glynn.Walden@audacy.com) or David Layer, VP, Advanced Engineering, National Association of Broadcasters (DLayer@nab.org).

Respectfully submitted,

Laura Berman
Vice President, Legal

Enclosure

cc: Priscilla Lee, FCC
John Kennedy, SVP of Technical Operations, Audacy
Paul Donovan, VP of Technical Operations, Audacy
Glynn Walden, Technical Consultant, Audacy
David Layer, VP, Advanced Engineering, NAB

[1] On March 30, 2021, Entercom License, LLC changed its name to Audacy License, LLC.

TECHNICAL REPORT – High-power FM Field Test Project – Stations WZMX and WIP

Summary

Audacy, working with partners National Association of Broadcasters (NAB) through the PILOT innovation initiative, Xperi Corporation, and broadcasters NY Public Radio (WNYC-FM), iHeartMedia, and Cox Media, participated in two field tests to evaluate the change to (desired) analog reception when the total HD power of an undesired 1st-adjacent channel signal is increased to -10 dBc. This technical report provides technical and logistical details of these two tests.

During the test periods (which were relatively brief, see Table 2) no reports of objectionable interference due to these tests were reported by listeners of WNYC (the desired station) or other stations, to the knowledge of the test team. Currently underway are subjective evaluations of the collected audio recordings to compare the perceived audio quality of the desired station when subjected to -10 and -14 dBc 1st-adjacent channel interferers.

Test description

Two separate field tests were conducted under this project, one on March 15, 2021 (Connecticut test, CT) and one on March 29, 2021 (New Jersey test, NJ). The location of each participating station and the test locations are shown in Figure 1.

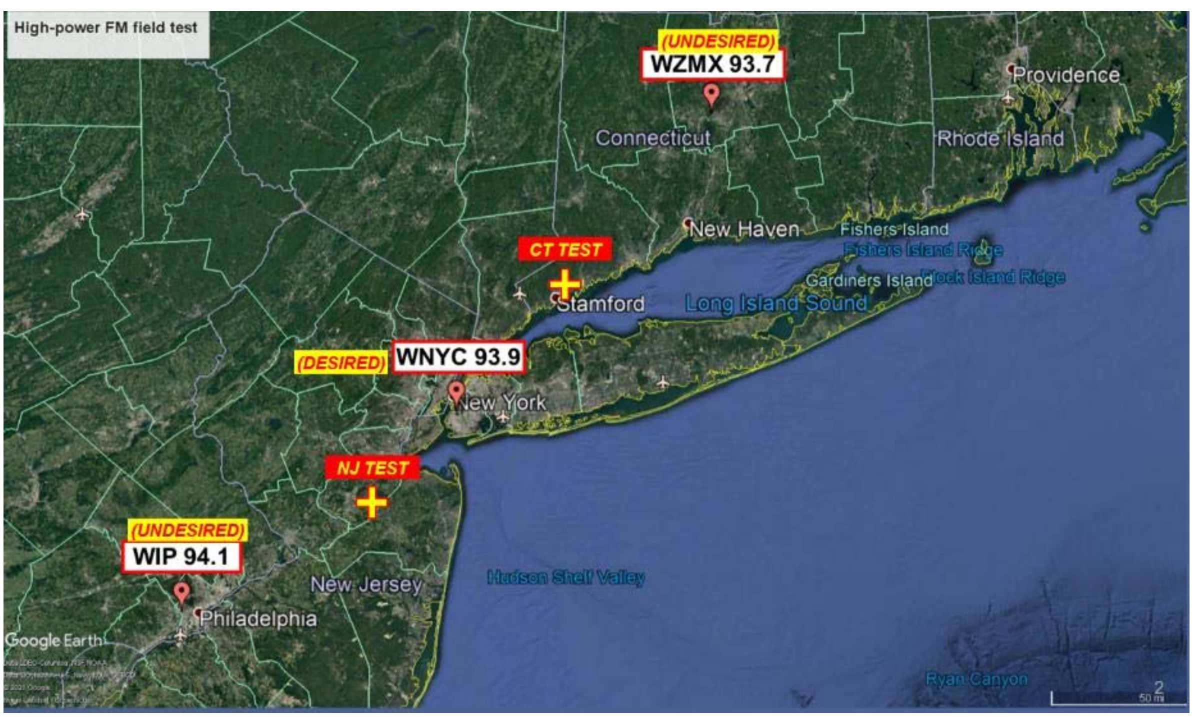


Figure 1. Map showing CT and NJ test locations as well as participating test stations.

Table 1 lists some technical information on the participating FM stations. For each test, audio recordings of the desired station (WNYC both times) were obtained using 4 different receivers, for two cases of undesired 1st-adjacent channel operation: at -14 dBc and -10 dBc digital power. Note that the Audacy stations (WZMX, WIP) were able to increase their digital transmit power for the -10 dBc portions of the test without alteration to the broadcast equipment chain. The test schedules are provided in Table 2.

Table 1. FM stations participating in the high-power FM field tests.

Parameter	WZMX	WIP	WNYC
Role	Undesired (CT)	Undesired (NJ)	Desired (CT, NJ)
Frequency (MHz)	93.7	94.1	93.9
Class	B	B	B
Power (kW)	17.0	9.6	5.2
Location	Hartford, CT	Philadelphia, PA	New York, NY
Licensee	Audacy		NYPR
Program format	Hip-hop	Sports	Public radio
LSB	-17.0	-17.0	-18.5
USB	-17.0	-17.0	-18.5
Lat	41.77417	40.04167	40.74844
Long	-72.80497	-75.23614	-73.98569

Table 2. High-power FM field test schedule.

Time	Description
Monday, March 15, 2021	
Noon	Conduct test (-14 dBc)
1PM	WZMX enters -10 dBc operation
	Conduct test (-10 dBc)
2PM	Start stationary recording (-10 dBc)
2:05PM	WZMX enters -14 dBc operation
2:10PM	Start stationary recording (-14 dBc)
2:15PM	End stationary recording
Monday, March 29, 2021	
Noon	Conduct test (-14 dBc)
1PM	WIP enters -10 dBc operation
	Conduct test (-10 dBc)
2PM	Begin stationary recording (-10 dBc)
2:05PM	WIP enters -14 dBc operation
2:10PM	Begin stationary recording (-14 dBc)
2:15PM	End stationary recording

A test route was developed for each test based upon the location of the protected contours of the desired and undesired stations, such that the test route was located just inside of the desired station's protected contour at the point closest to the protected contour of the undesired station. Maps of the two test routes utilized are shown in Figure 2 through Figure 5. Each test route took approximately 45 minutes of drive time. Following the mobile testing, short stationary recordings of the desired audio were made, as well.

Audio recordings of the desired station's audio were made simultaneously for three aftermarket consumer FM receivers and one FM chipmaker's evaluation board (see data collection block diagram shown in Figure 6). These receivers were either analog-only or HD Radio receivers operated in analog mode since the goal of the tests is to assess the impact of the 1st-adjacent channel undesired signal on desired *analog* audio performance. One of the benefits of using the eval board was that additional technical data on receiver performance was available and collected for future analysis.

Test results

The principal data collected during these field tests were the audio recordings of the four receivers under each test condition (see Table 3). These were captured simultaneously and stored as .wav files (uncompressed audio). As previously mentioned, additional data was available from the FM chipset eval board but this was ancillary and collected primarily as a reference for future study of the audio files. Also collected was information from an RF signal analyzer, again for future reference.

Currently these audio files are being analyzed to obtain meaningful, short (1-2 minutes in length) clips that can be subjectively evaluated to determine how listeners rate the audio clips with -10 dBc and -14 dBc interferers.

Table 3. Audio recordings obtained during field tests (ET is elapsed time).

		-14 dBc		-10 dBc	
Description		# of recordings	Total ET (min)	# of recordings	Total ET (min)
CT test	Mobile	4	180	4	180
	Stationary	4	40	4	40
NJ test	Mobile	4	180	4	180
	Stationary	4	40	4	40

TOTAL - 14.7 hours of audio

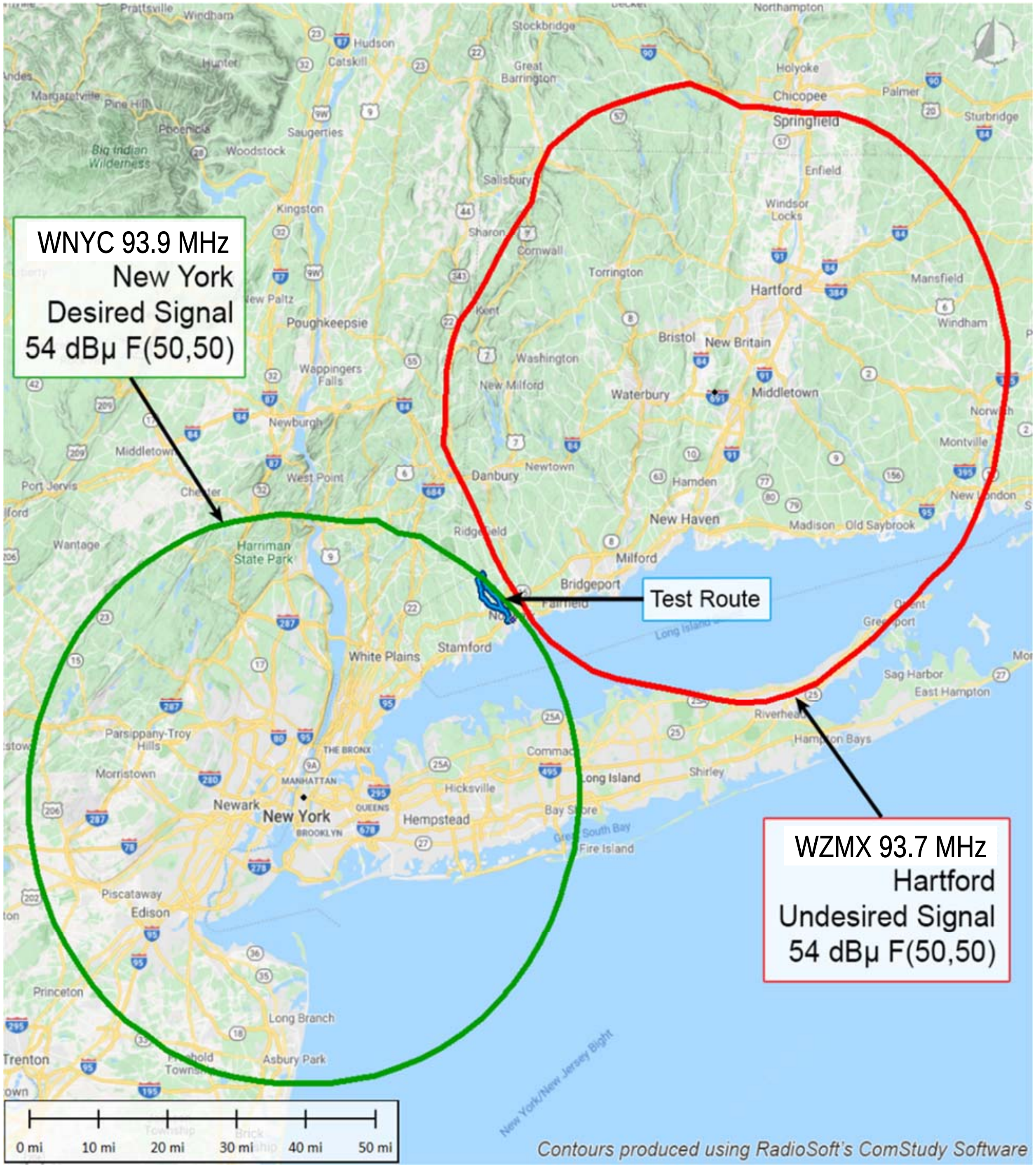


Figure 2. Route map – CT test, overview.

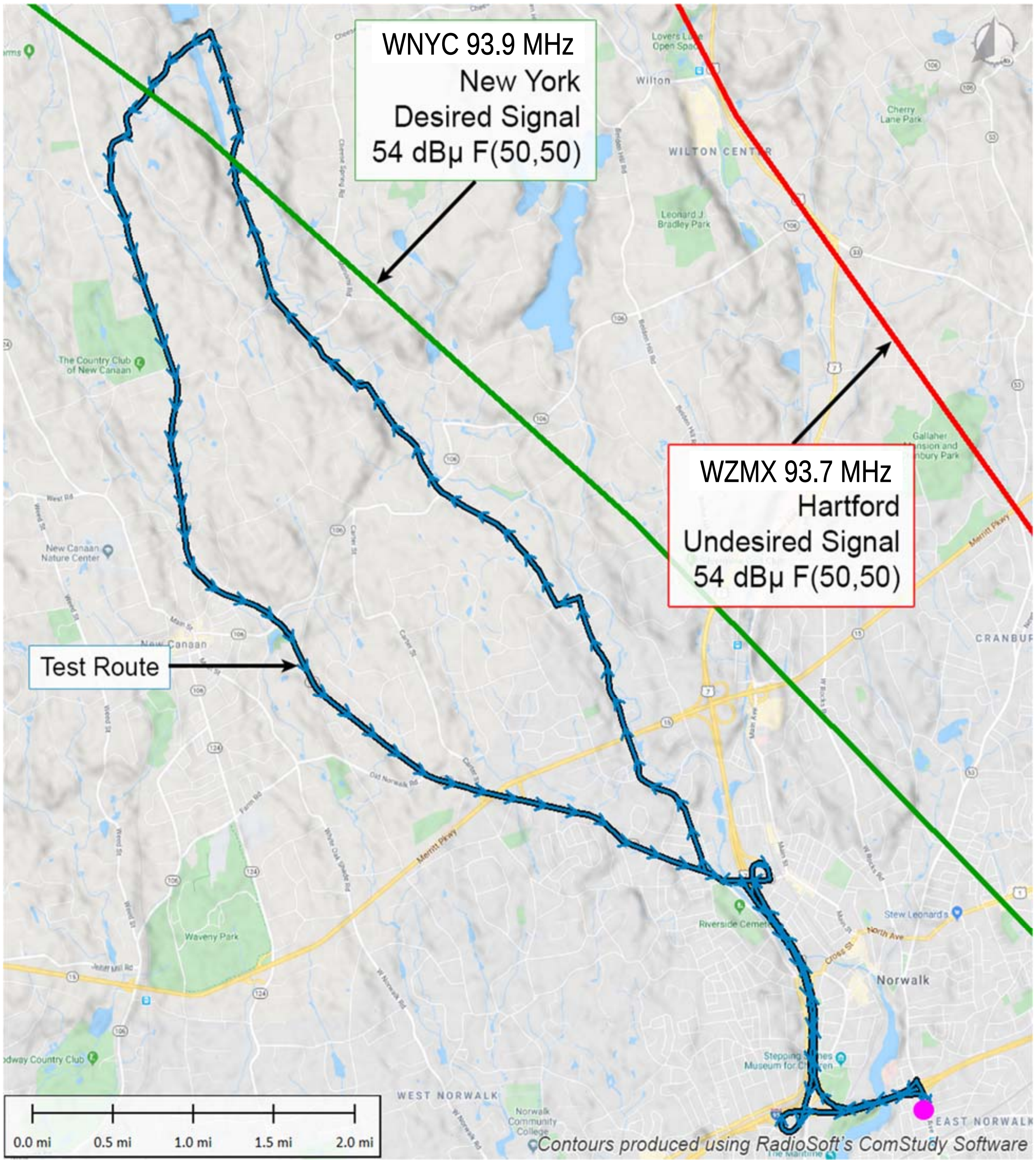


Figure 3. Route map – CT test, detail.

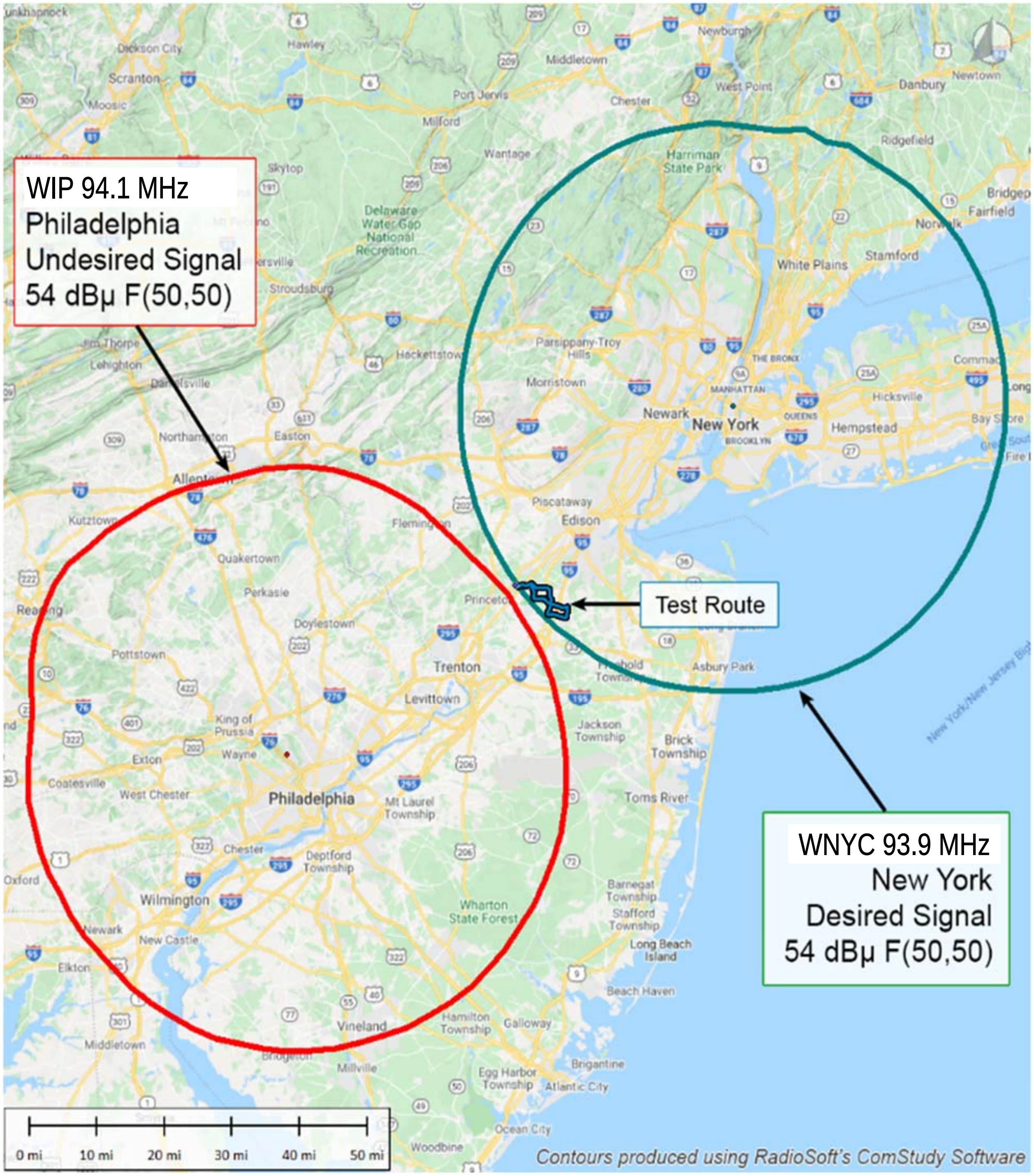


Figure 4. Route map, NJ test, overview.

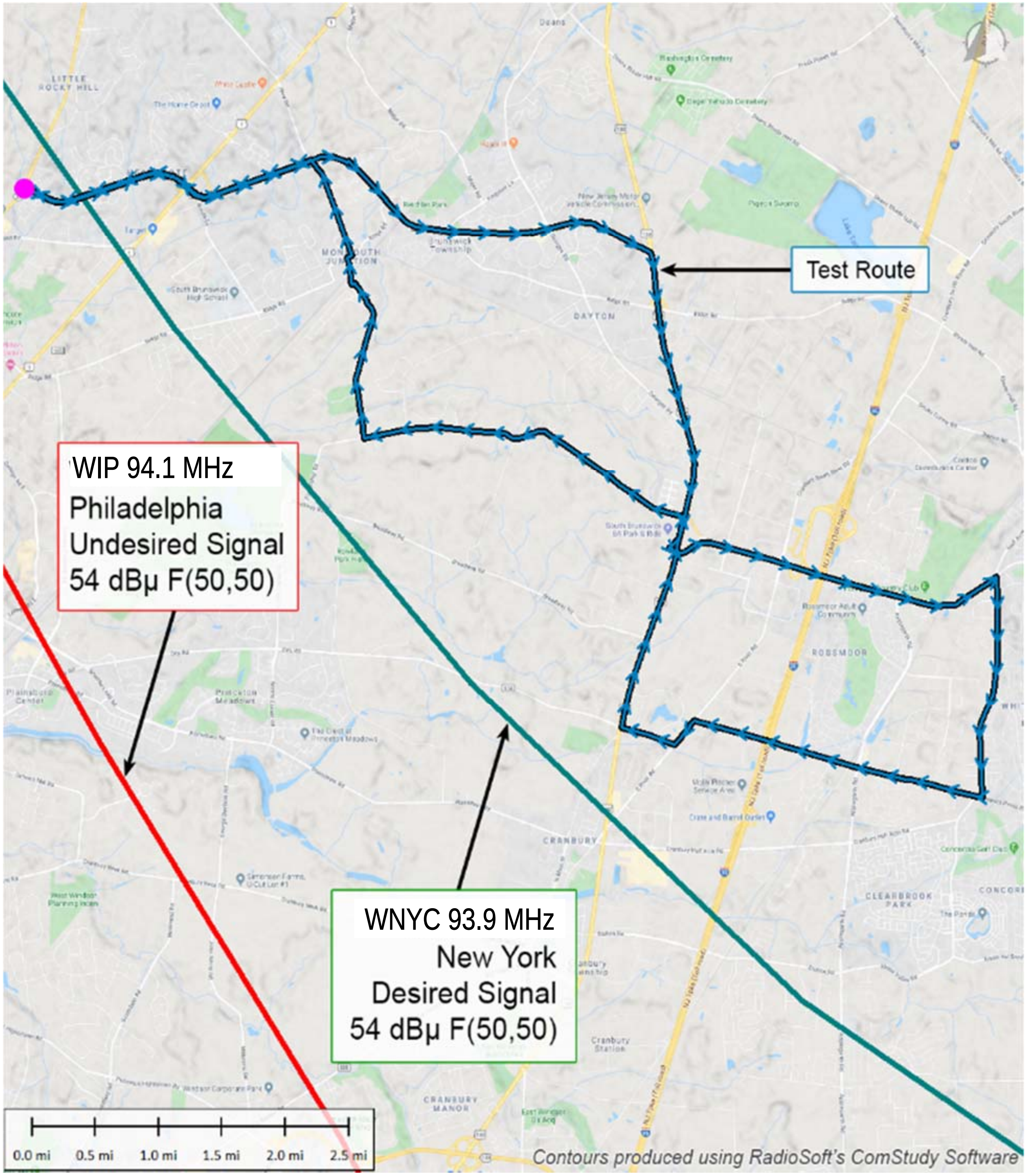


Figure 5. Route map, NJ test, detail.

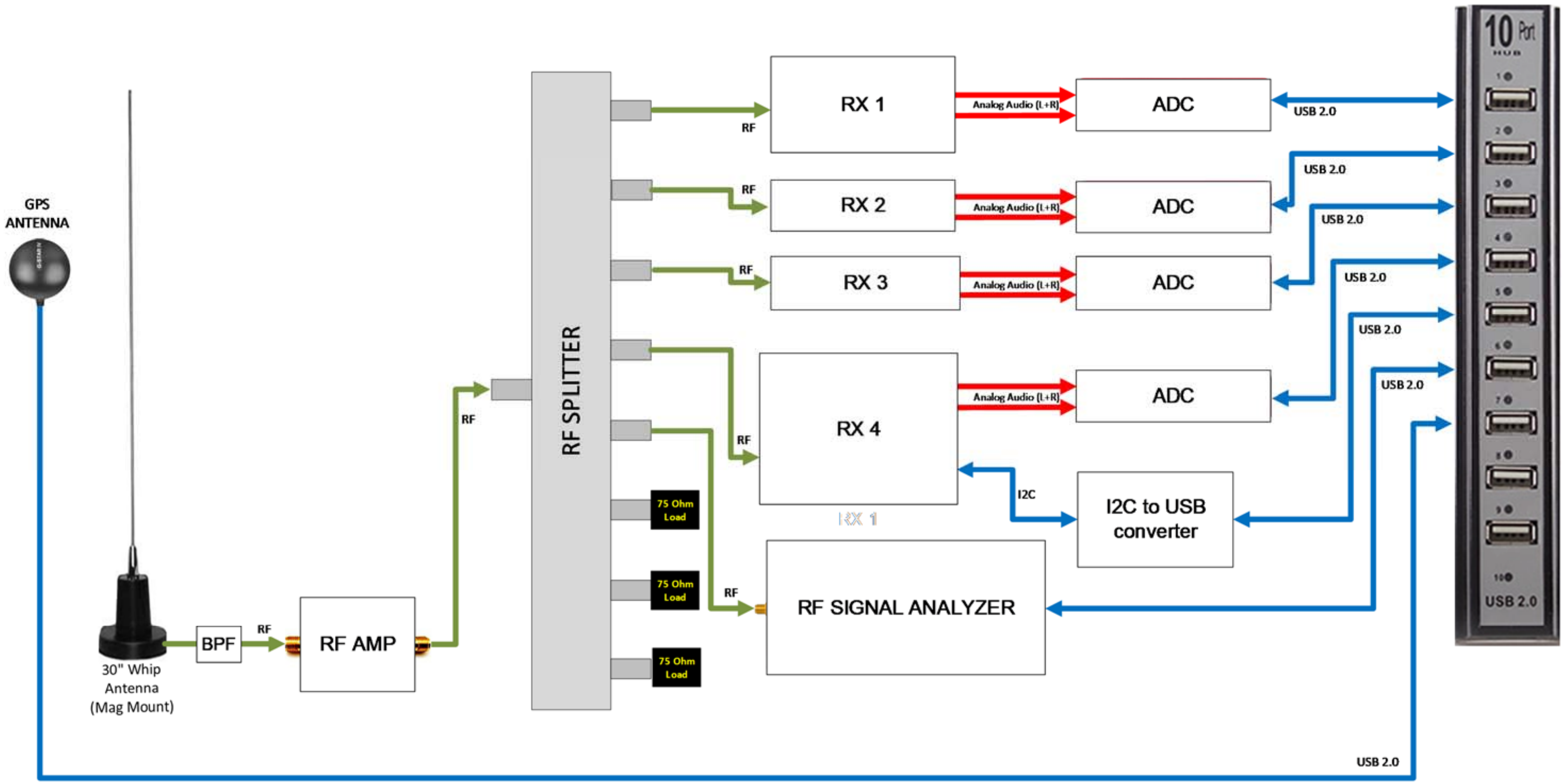


Figure 6. Data collection equipment block diagram.

APPENDIX 3

NAB presentation on High-power FM Field Test Project including analysis of results

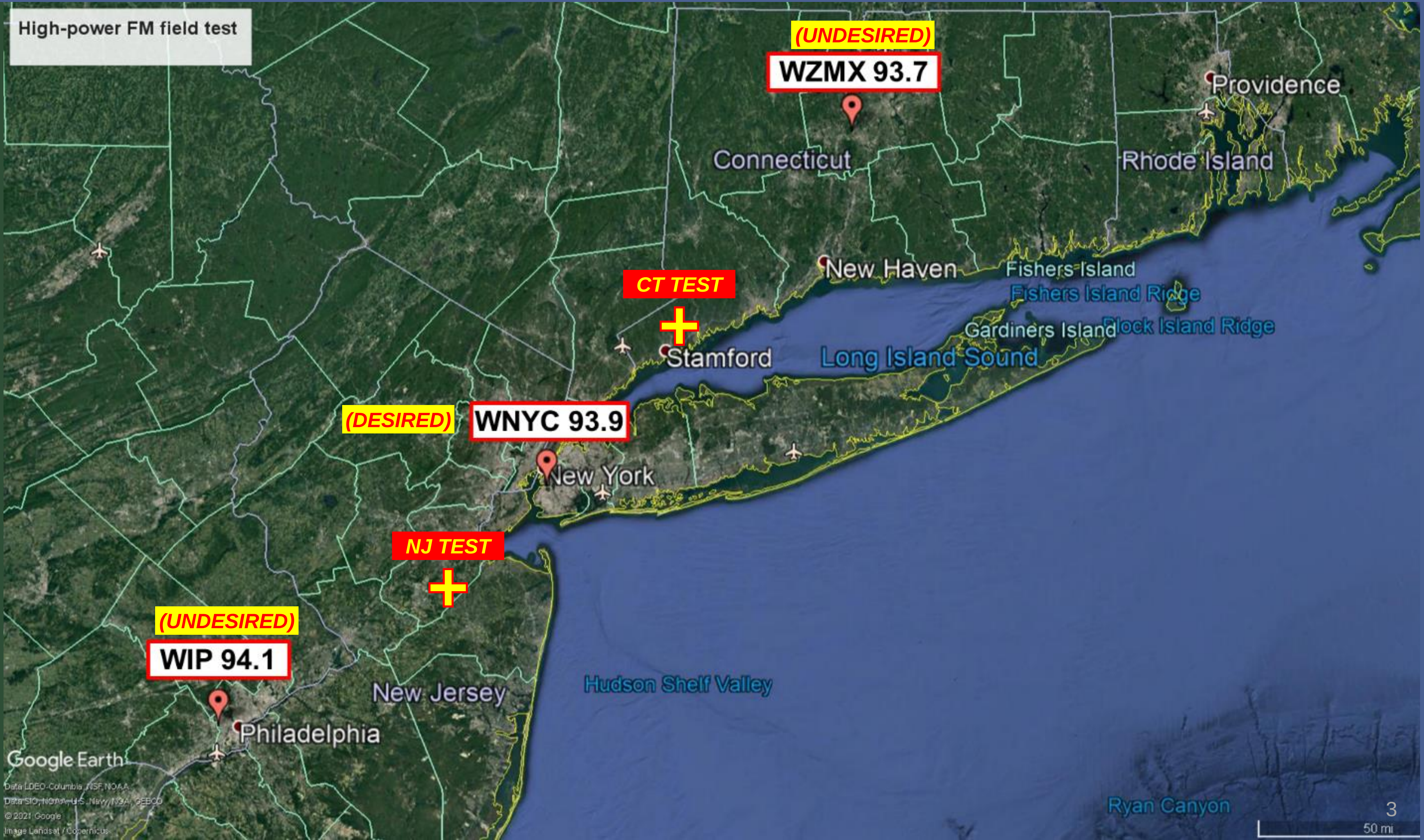
High-power FM field test project

- Digital power increase adopted by FCC on **January 27, 2010**
  - -14 dBc blanket authorization for all but superpowered FM stations
  - For power from -14 to -10 dBc, need to submit an engineering analysis
- Goal of this project is to develop new formula for power increase, then develop and submit Petition to FCC
  - Avoid need for engineering analysis by stations wanting an increase
  - Would better replicate analog coverage
  - Issue is whether this would create too much interference

High-power FM field test project

- Test stations:
  - IBOC undesired and analog desired stations are 1st-adjacent to one another

DATE	IBOC UNDESIRED STATION		ANALOG DESIRED STATION	
3/15/21 (CT)	**WZMX** (Audacy)	Hartford, CT	**WNYC** (NY Pub. Radio)	New York, NY
3/29/21 (NJ)	**WIP** (Audacy)	Philadelphia, PA	**WNYC** (NY Pub. Radio)	New York, NY



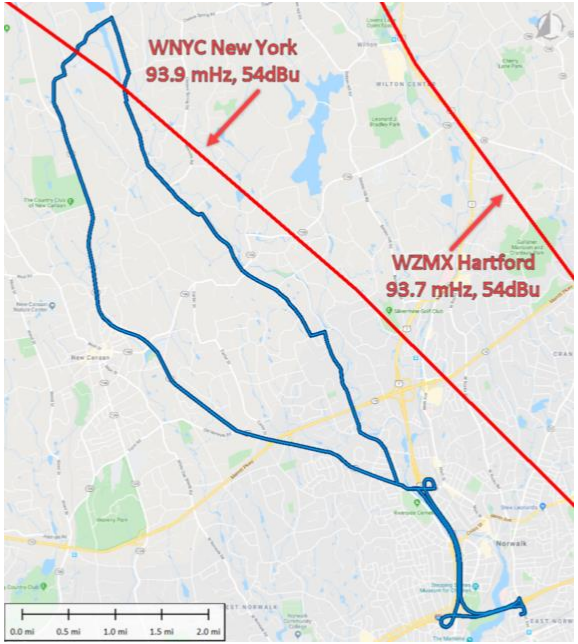
High-power FM field test
(UNDESIRED)
WZMX 93.7
Providence
Connecticut
Rhode Island
New Haven
Fishers Island
Fishers Island Ridge
CT TEST
Gardiners Island
Block Island Ridge
Stamford
Long Island Sound
(DESIRED)
WNYC 93.9
New York
NJ TEST
(UNDESIRED)
WIP 94.1
New Jersey
Hudson Shelf Valley
Philadelphia
Google Earth
Ryan Canyon
50 mi

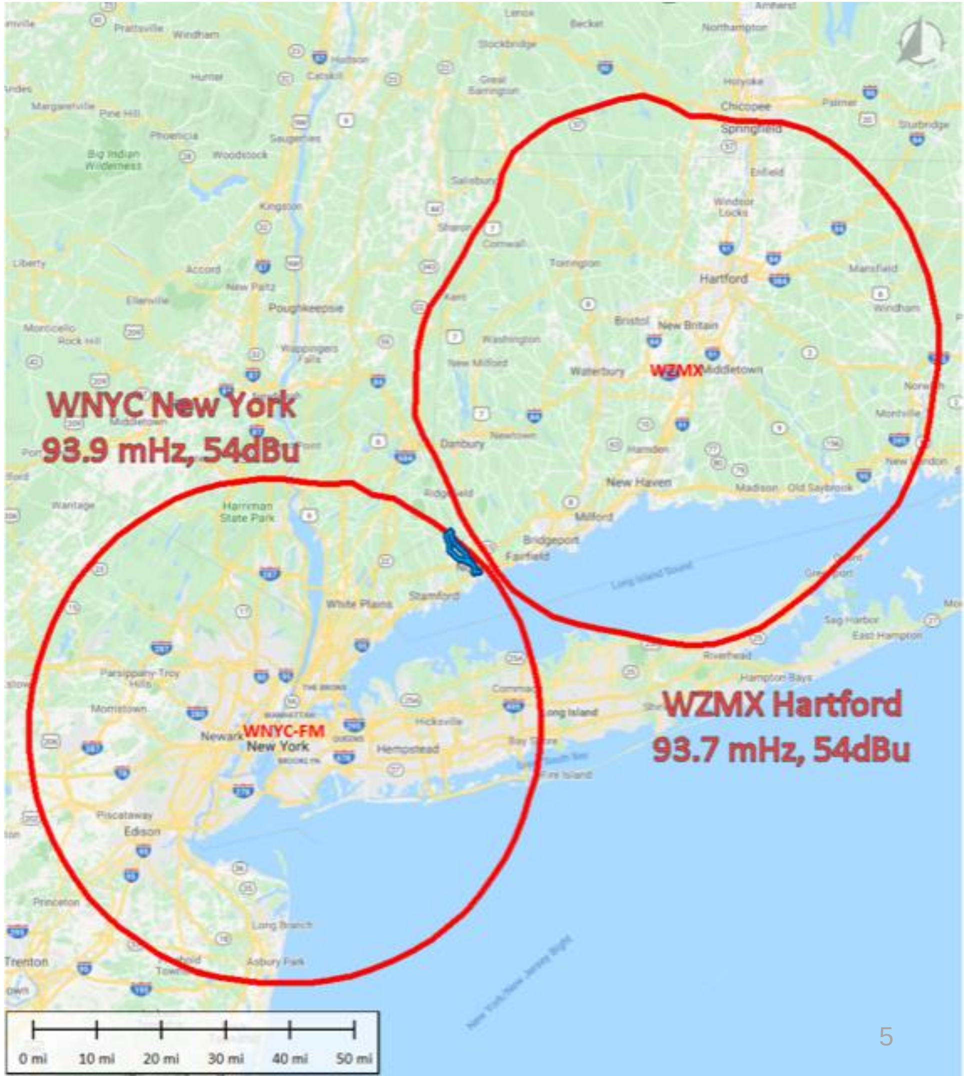
High-power FM field test project

- Test plan:
  - Record desired audio when subjected to both -14 and -10 dBc 1st-adj IBOC undesired signal
  - Compare desired audio files in a subjective evaluation to see if performance is any different
  - Test routes chosen at the edge of desired station protected contour
  - Use four receivers to capture audio

Connecticut route

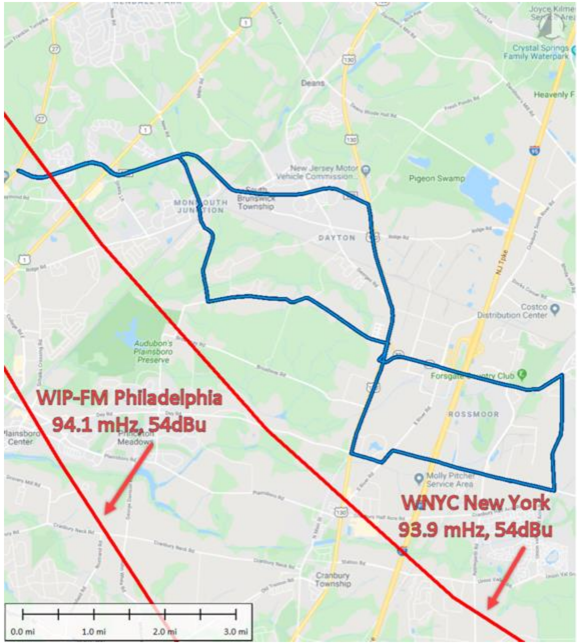
- Undesired IBOC station – WZMX (Audacy)
- Desired analog station – WNYC (NYPR)
- 3/15

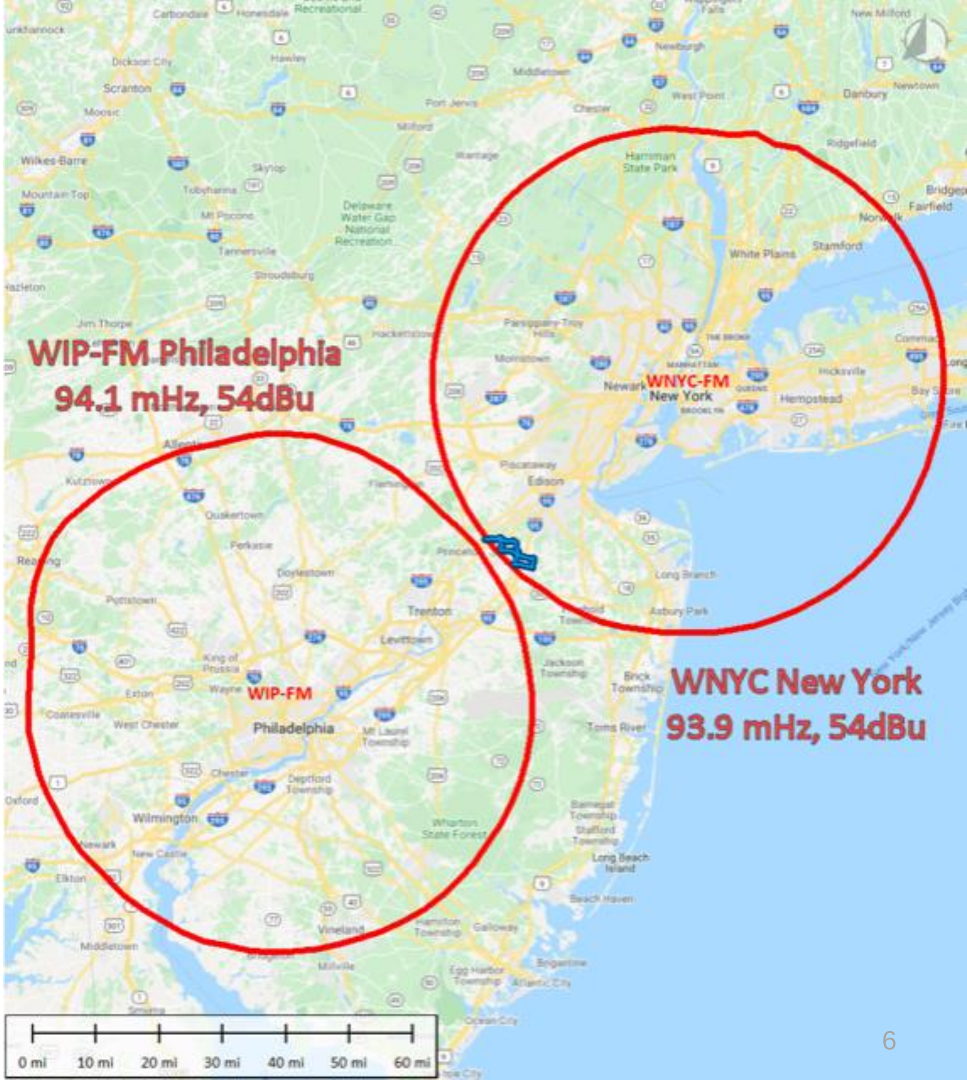




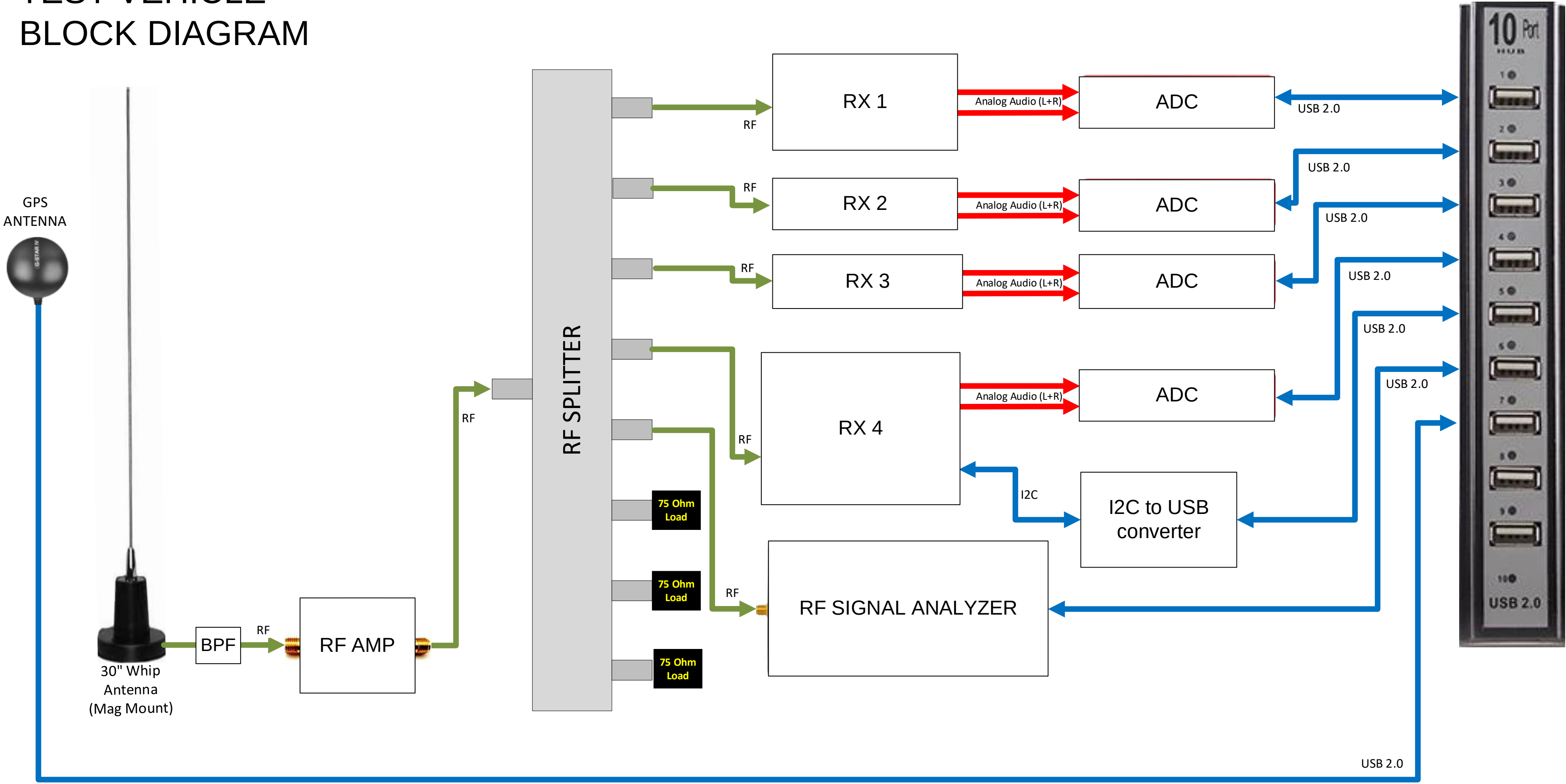
New Jersey route

- Undesired IBOC station – WIP (Audacy)
- Desired analog station – WNYC (WNYC)
- 3/22





TEST VEHICLE BLOCK DIAGRAM



High-power FM field test project

- Collected over 14 hours of audio
- Must reduce number and length of audio files so that a reasonable subjective evaluation can be performed

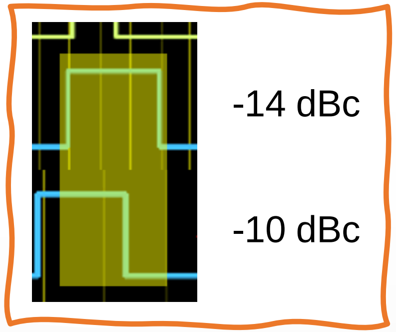
		-14 dBc		-10 dBc	
		#	ET (min)	#	ET (min)
CT test	Mobile	4	180	4	180
	Stationary	4	40	4	40
NJ test	Mobile	4	180	4	180
	Stationary	4	40	4	40
	TOTAL	**14.7**	**hours of audio**		

High-power FM field test project

- Used Xperi analysis tool to identify locations of interest:
  - Post-processed the received desired signal using a prototype broadcast-streaming audio switching algorithm
  - Using tuner-based RF signal metrics, identifies areas where a hybrid radio receiver would switch from over-the-air to streaming audio
  - Results very similar for -14, -10 dBc cases and show over-the-air audio was mostly unlistenable (not surprising since at the edge of protected contour)

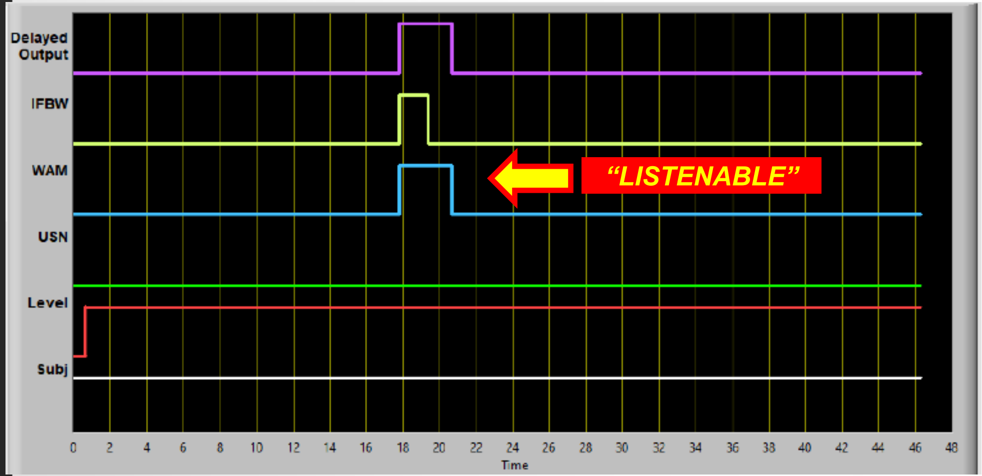
High-power FM field test project - CT

- Subjective evaluation process:
  - Using Xperi tool, identified area of interest for listening (“excerpt 1”)
  - Identified area (CT) is 4 min 0 sec in length, includes both “listenable” and “unlistenable” audio (-10 dBc) according to Xperi tool

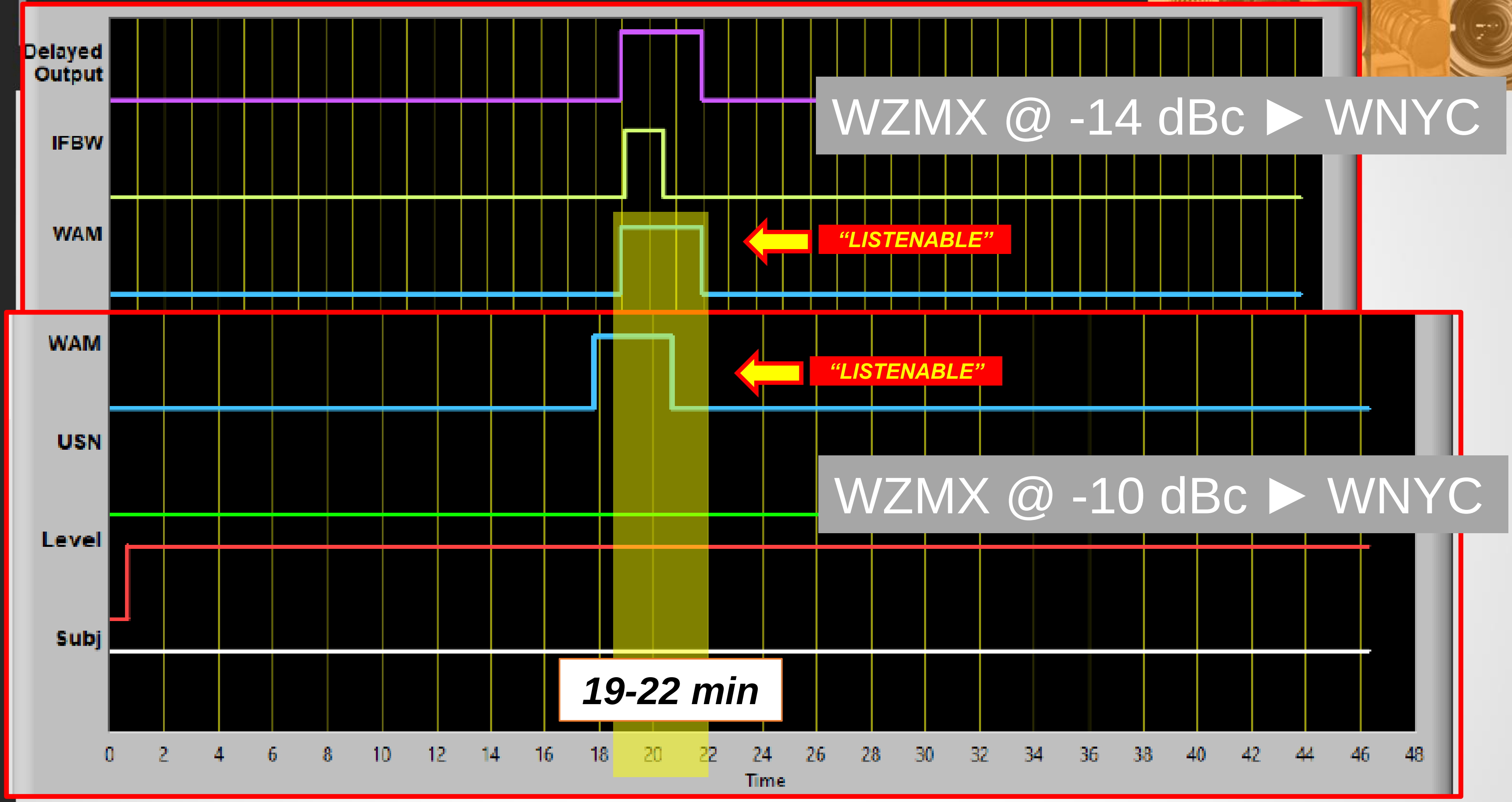


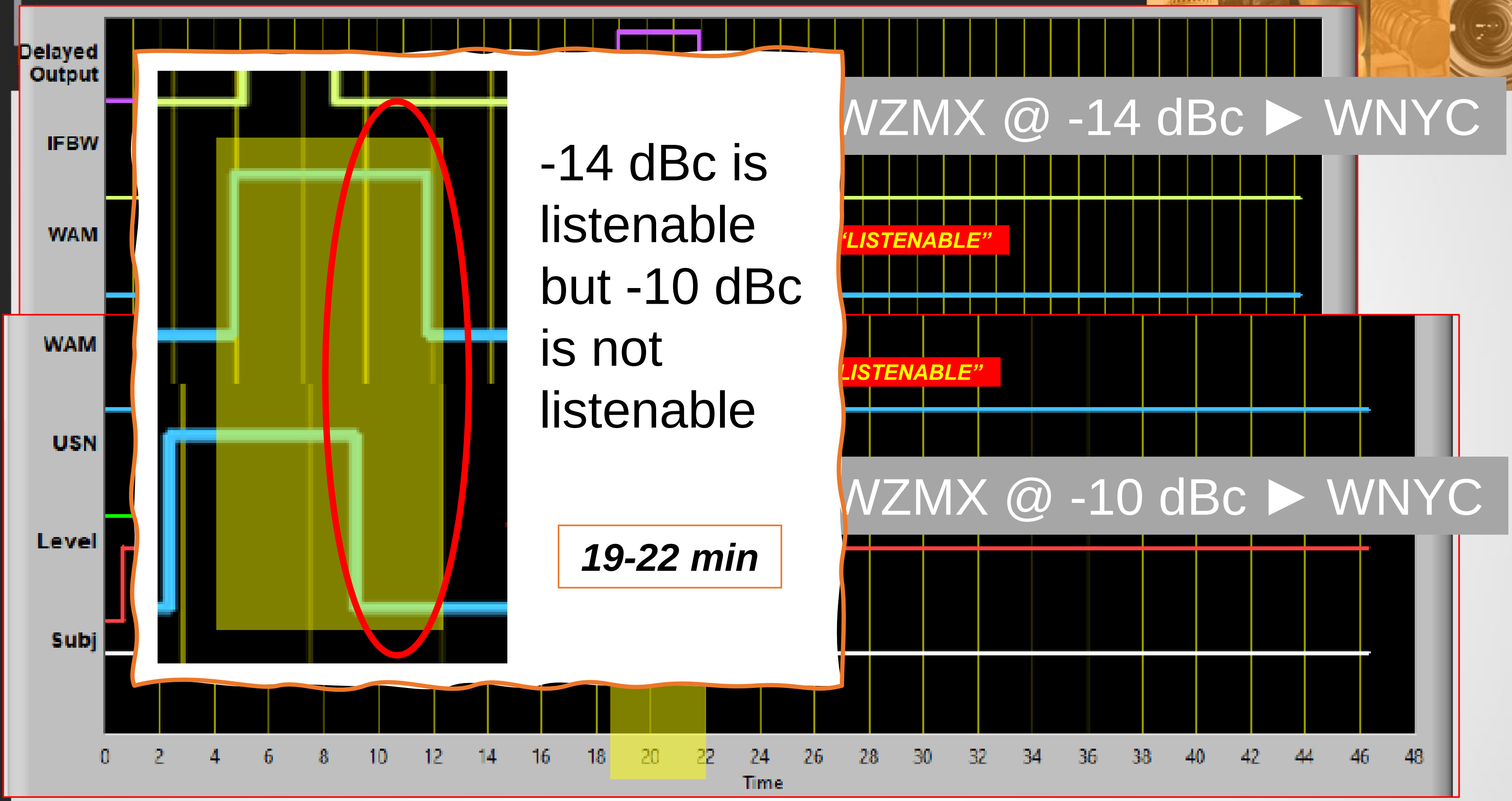
WZMX @ -14 dBc ► WNYC

ELAPSED TIME →



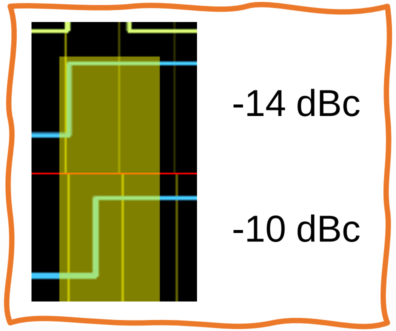
WZMX @ -10 dBc ► WNYC

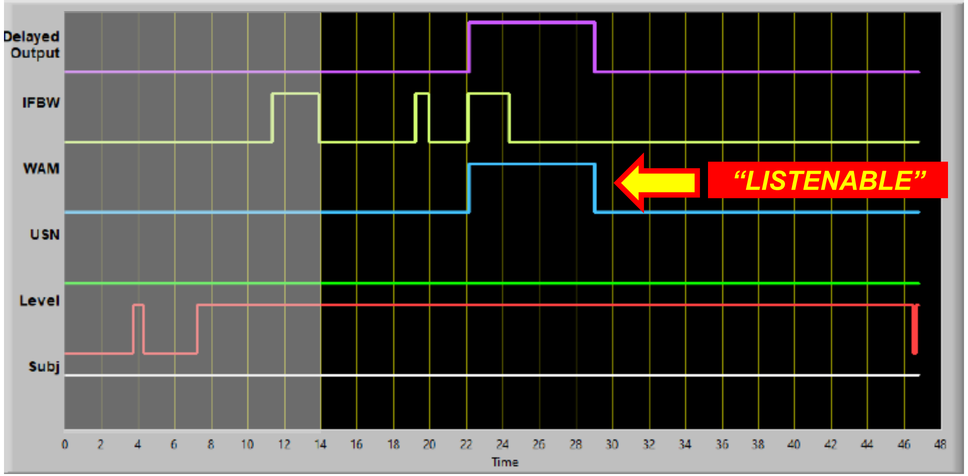

Delayed Output
IFBW
WAM
WAM
USN
Level
Subj
WZMX @ -14 dBc ► WNYC
"LISTENABLE"
"LISTENABLE"
WZMX @ -10 dBc ► WNYC
19-22 min
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time


Delayed Output
IFBW
WAM
WAM
USN
Level
Subj
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48
Time
WZMX @ -14 dBc ► WNYC
"LISTENABLE"
"LISTENABLE"
WZMX @ -10 dBc ► WNYC
-14 dBc is listenable but -10 dBc is not listenable
19-22 min

High-power FM field test project - NJ

- Subjective evaluation process:
  - Using Xperi tool, identified area of interest for listening (“excerpt 1”)
  - Identified area (NJ) is 4 min 0 sec in length, includes both “listenable” and “unlistenable” audio (-10 dBc) according to Xperi tool

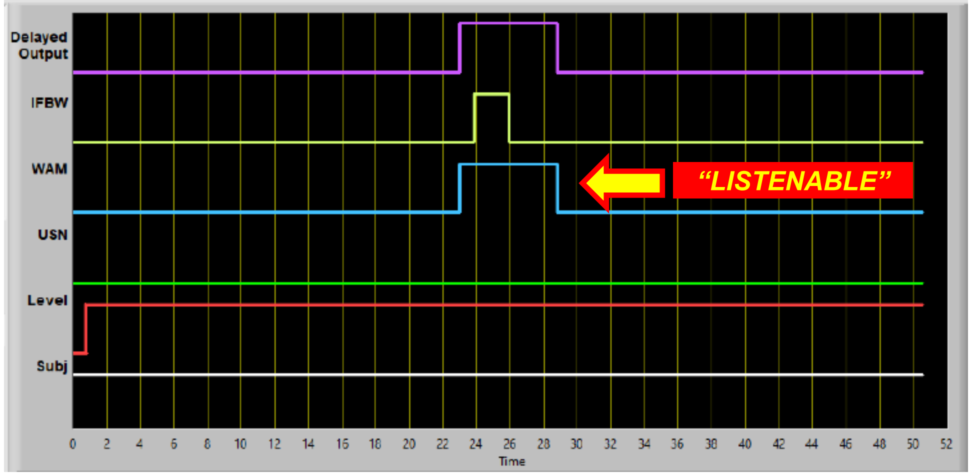




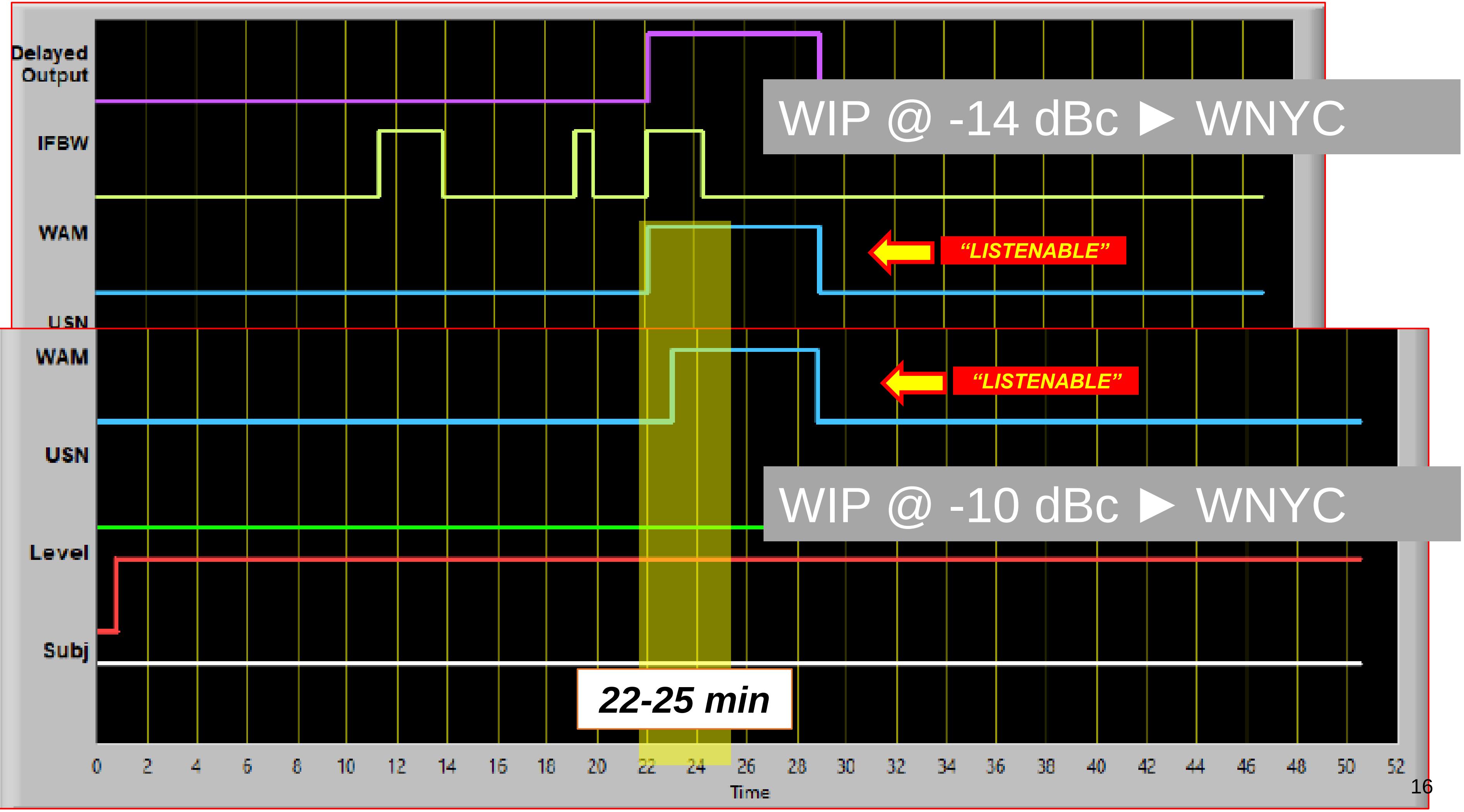
WIP @ -14 dBc ► WNYC

(first 14 minutes invalid due to tuner issue)

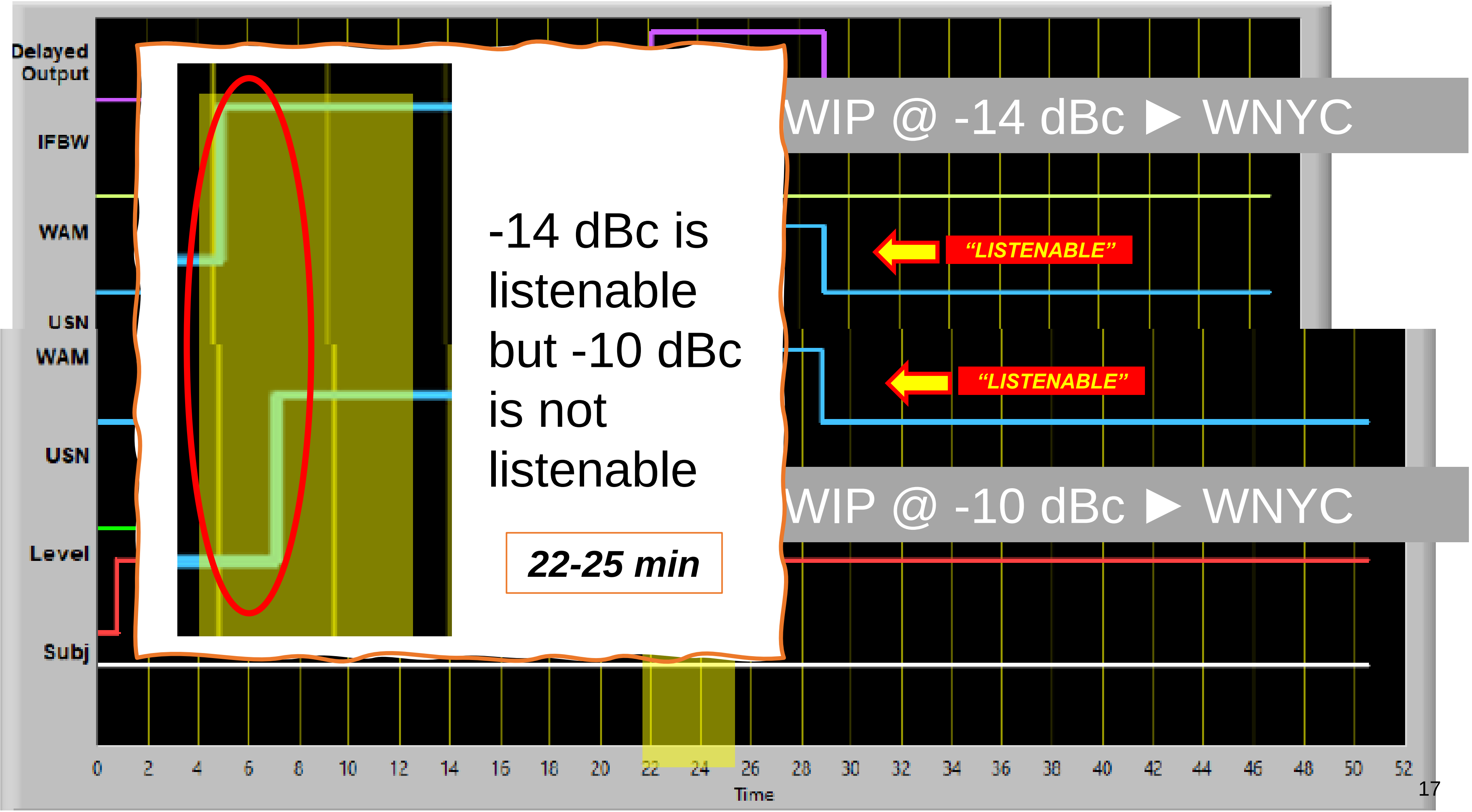
TIME →



WIP @ -10 dBc ► WNYC



Delayed Output
IFBW
WAM
USN
WAM
USN
Level
Subj
WIP @ -14 dBc ▶ WNYC
"LISTENABLE"
"LISTENABLE"
WIP @ -10 dBc ▶ WNYC
22-25 min
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52
Time


Delayed Output
IFBW
WAM
USN
WAM
USN
Level
Subj
-14 dBc is listenable but -10 dBc is not listenable
22-25 min
WIP @ -14 dBc ▶ WNYC
"LISTENABLE"
"LISTENABLE"
WIP @ -10 dBc ▶ WNYC
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52
Time

High-power FM field test project

- Subjective evaluation process (con't):
  - Test team listened to excerpt 1 for NJ and CT tests and identified specific areas of interest ("excerpt 2") 1 min 11 sec (NJ) and 1 min 16 sec (CT) in length
  - Audio in excerpt 2 was significantly worse than the rest of excerpt 1 for each case
  - Extracted excerpt 2 for all 16 mobile audio files (2 locations x 4 receivers x 2 power levels) and anonymized for subjective evaluation

High-power FM field test project

- Subjective evaluation test
  - 16 audio clips:
    - 8 are 1 min 11 sec (-10) or 1 min 07 sec (-14) in length (NJ test)
    - 8 are 1 min 16 sec (-10) or 1 min 23 sec (-14) in length (CT test)
  - Difference in audio clip length for a given test is due to matching of **start and stop locations** for each test run (-10 and -14), and that travel times between these locations were slightly different (NJ 4 sec, CT 7 sec)

High-power FM field test project

- Subjective evaluation test
  - Subjects listen to audio files and compare, rating from 1 (unlistenable) to 5 (excellent quality)
  - Audio files are anonymous and randomized from the perspective of the test subject
  - Tested by test crew (5 panelists) and by NAB Radio Technology Committee (NABRTC) volunteers (5 panelists)

High-power FM

- Subjective evaluation test
  - Subjects listen to audio files and 5 (excellent quality)
  - Audio files are anonymous and ra test subject
  - Tested by test crew (5 panelists)

NABRTC audio subjective evaluation data sheet

PLEASE RETURN TO dlayer@nab.org

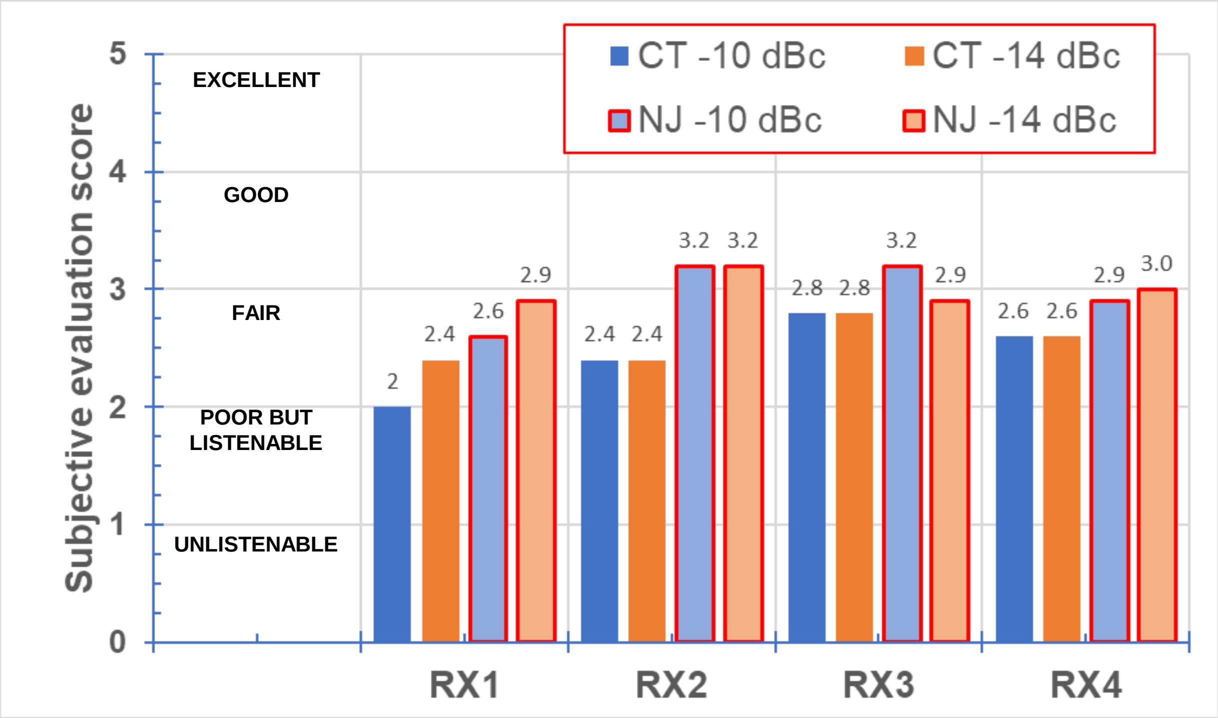
Your name –
Today's date –
Listening device – <closed headphones preferred>

Audio file	Ranking (1-5)	Comments
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

1 - unlistenable
2 - poor quality but listenable
3 - fair quality
4 - good quality
5 - excellent quality

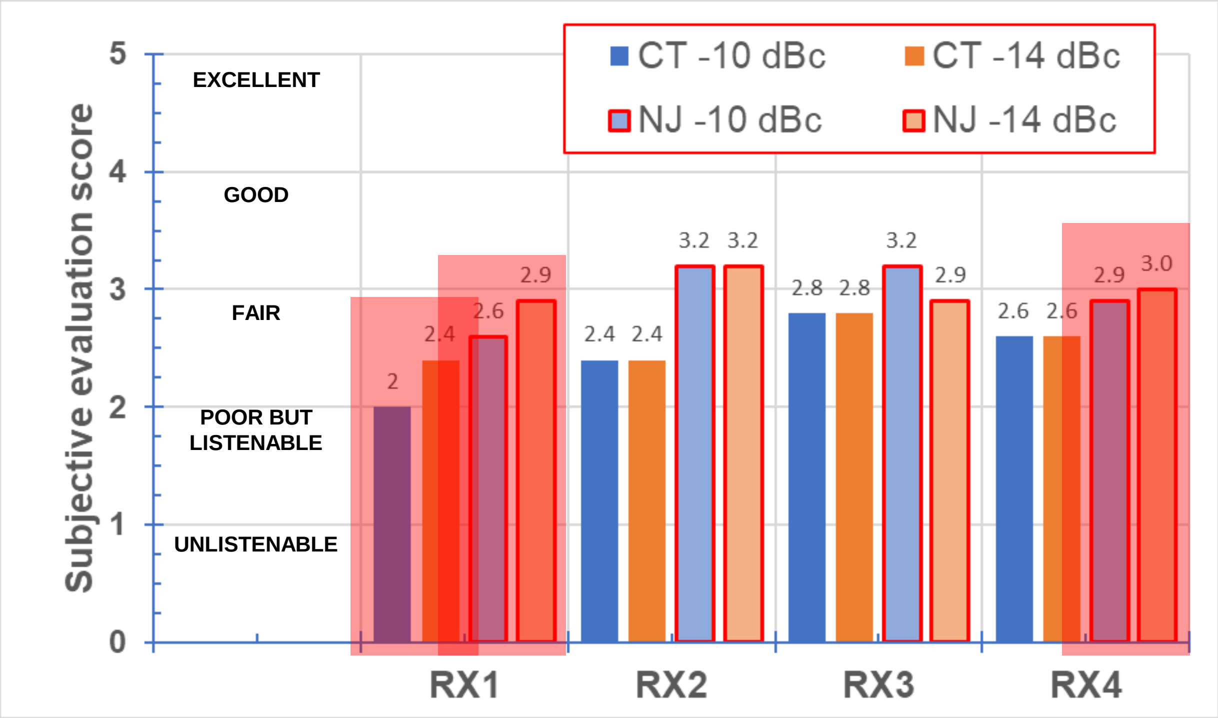
Subjective evaluation results – test team

- 3 outcomes:
  - -10 sounds worse than -14
  - -10 and -14 sound the same
  - -14 sounds worse than -10



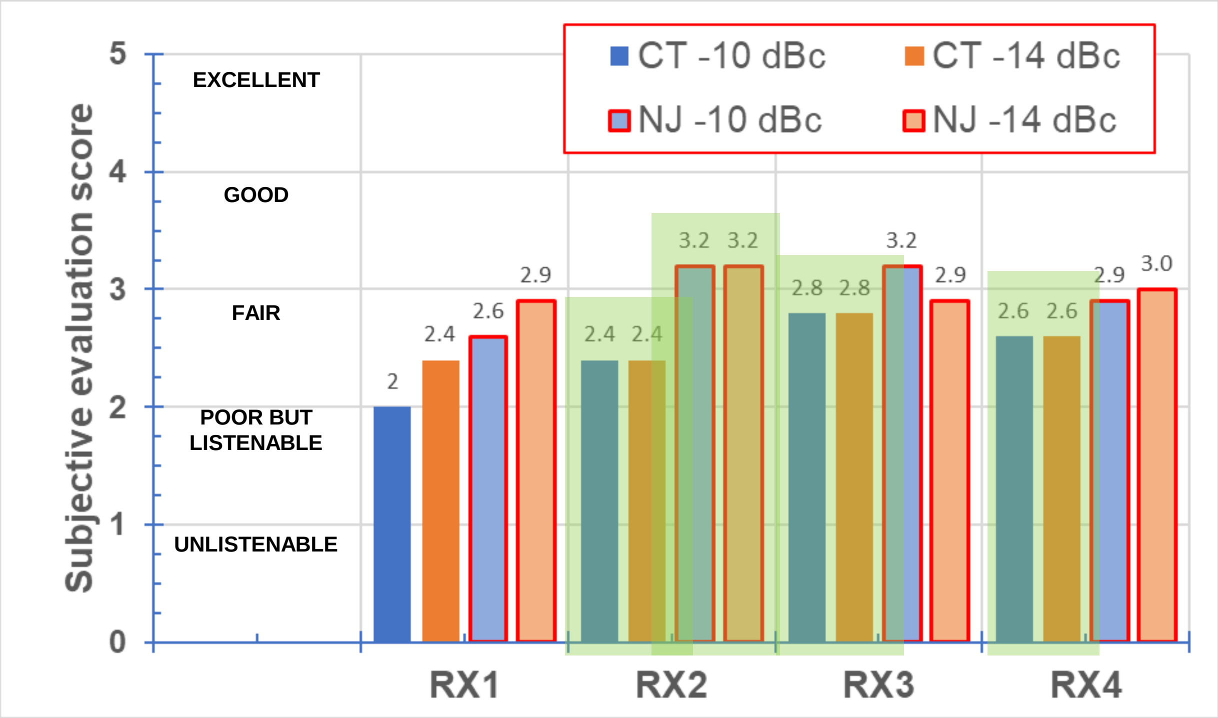
Subjective evaluation results – test team

- 3 outcomes:
  - -10 sounds worse than -14 **[3]**
  - -10 and -14 sound the same [4]
  - -14 sounds worse than -10 [1]



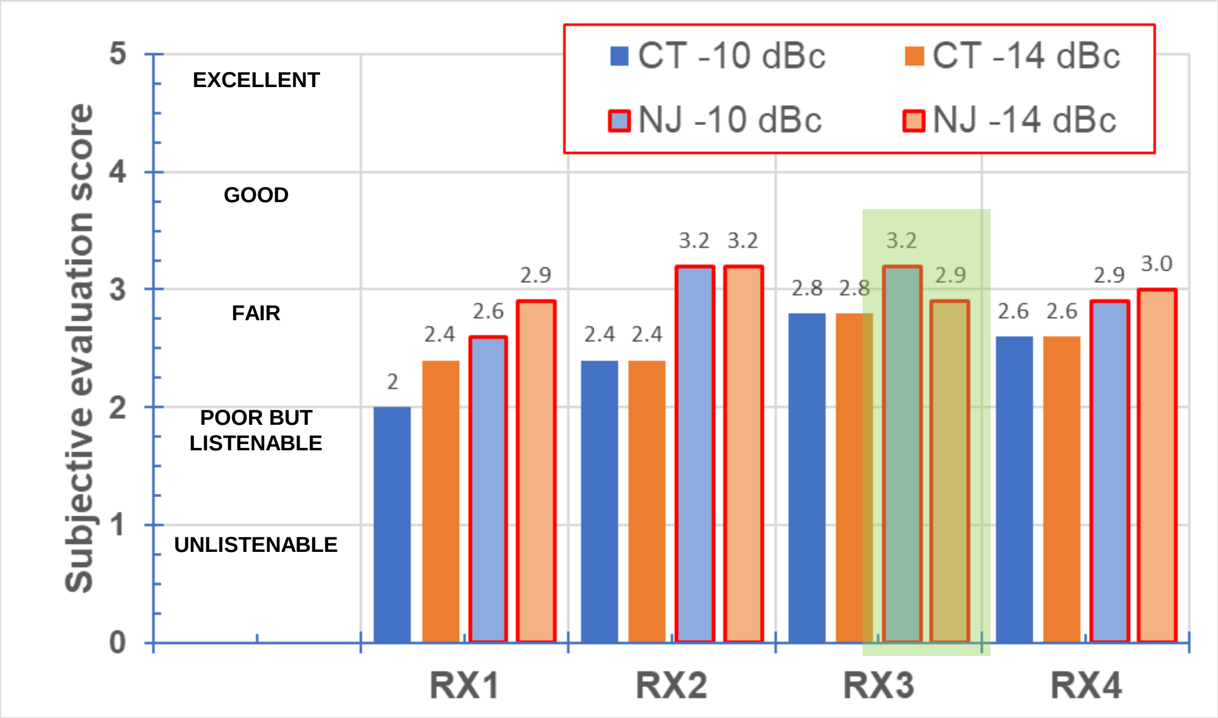
Subjective evaluation results – test team

- 3 outcomes:
  - -10 sounds worse than -14 [3]
  - -10 and -14 sound the same [4]
  - -14 sounds worse than -10 [1]



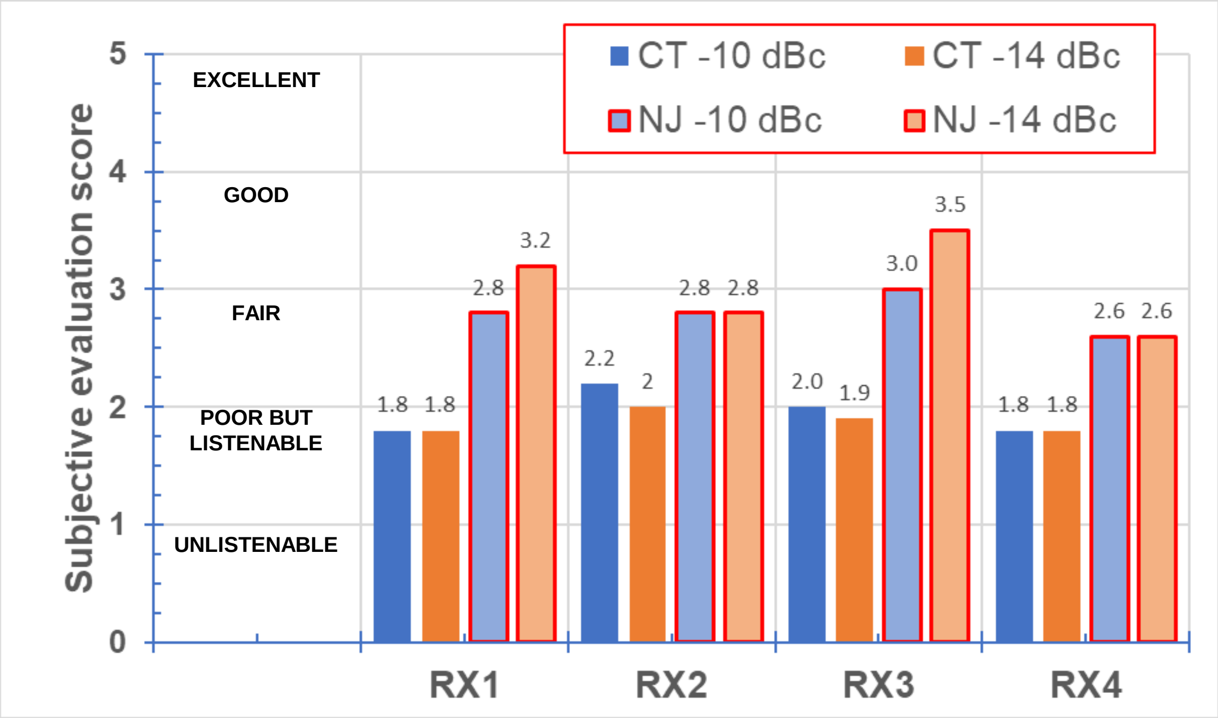
Subjective evaluation results – test team

- 3 outcomes:
  -10 sounds worse than -14
  -10 and -14 sound the same
  -14 sounds worse than -10 [1]



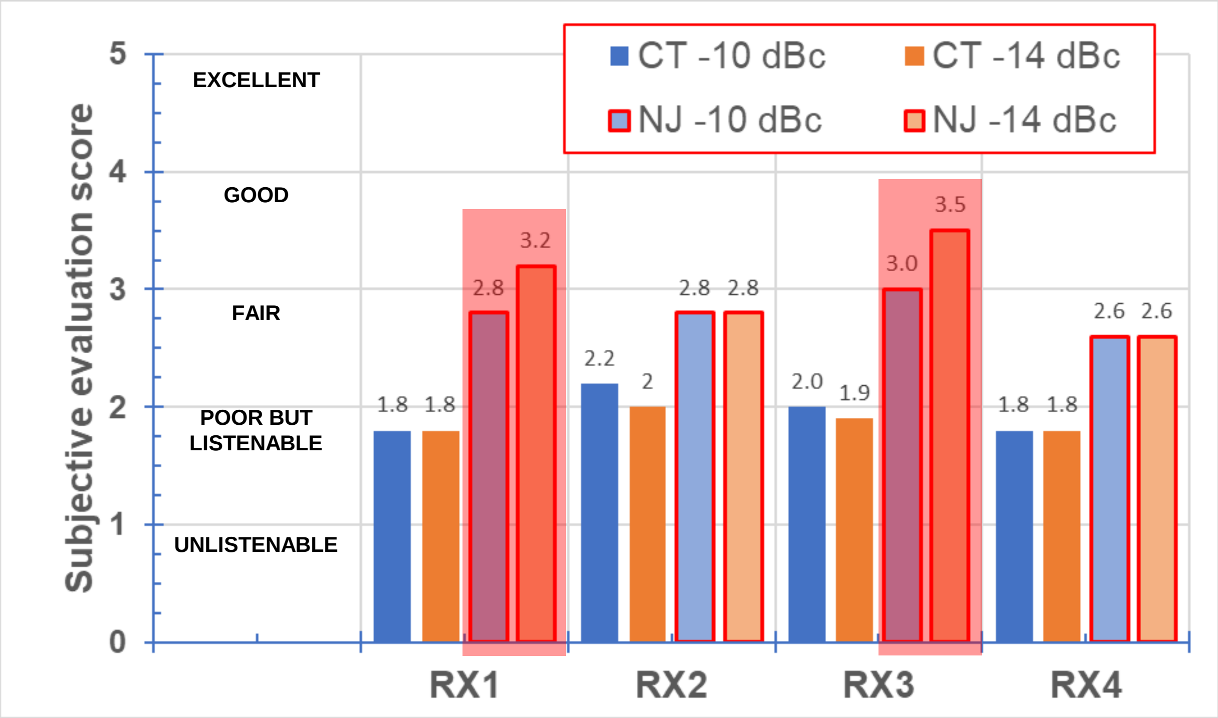
Subjective evaluation results - NABRTC

- 3 outcomes:
  -10 sounds worse than -14
  -10 and -14 sound the same
  -14 sounds worse than -10



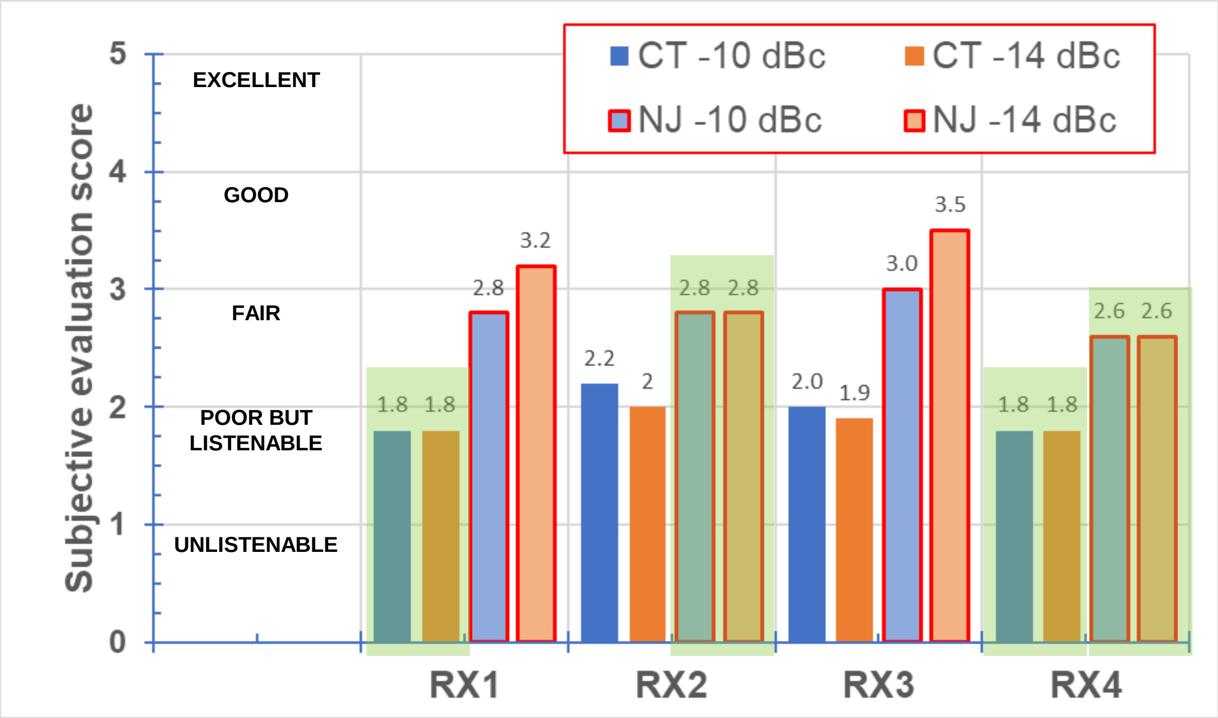
Subjective evaluation results - NABRTC

- 3 outcomes:
  - -10 sounds worse than -14 [2]
  - -10 and -14 sound the same [4]
  - -14 sounds worse than -10 [2]



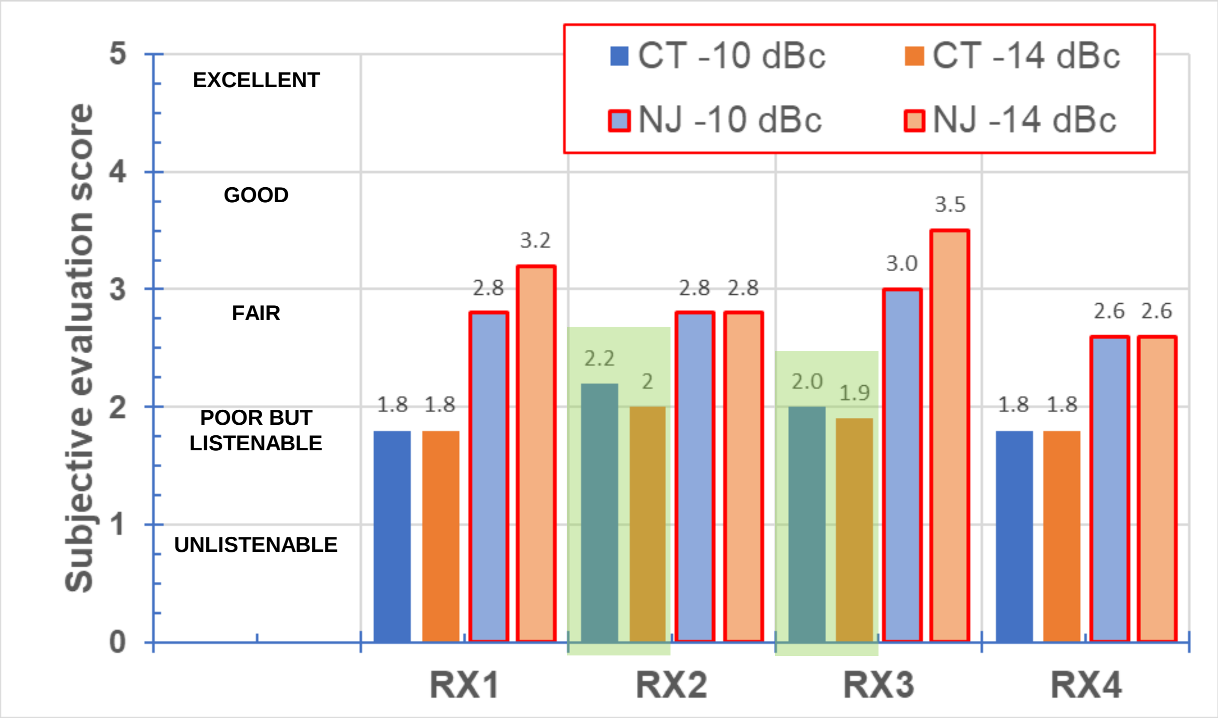
Subjective evaluation results – NABRTC

- 3 outcomes:
  - -10 sounds worse than -14 [2]
  - -10 and -14 sound the same [4]
  - -14 sounds worse than -10 [2]



Subjective evaluation results - NABRTC

- 3 outcomes:
  - -10 sounds worse than -14 [2]
  - -10 and -14 sound the same [4]
  - -14 sounds worse than -10 [2]



Subjective evaluation results

- No significant difference in audio quality as a function of interferer
- Table highlights difference between -10 and -14 interference cases for each receiver and location

	Test team		NABRTC	
	CT	NJ	CT	NJ
RX1	-0.4	-0.3	0	-0.4
RX2	0	0	0.2	0
RX3	0	0.3	0.1	-0.5
RX4	0	-0.1	0	0

(Numbers are difference in subjective eval score)

(Subjective eval score ranges from 1=poor to 5=excellent)

Key:

Red	-10 sounds worse than -14
Green	-10 and -14 sound the same
Green	-14 sounds worse than -10