Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Comment Sought on Competitive Bidding Procedures for Broadcast Incentive Auction 1000, Including Auctions 1001 and 1002	)	AU Docket No. 14-252
	)	
Expanding the Economic and Innovation Opportunities of Spectrum through Incentive Auctions	)	GN Docket No. 12-268

COMMENTS OF THE ADVANCED TELEVISION BROADCASTING ALLIANCE

Louis Libin
Executive Director
Advanced Television Broadcasting Alliance

June 3, 2015

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To: The Commission

COMMENTS OF
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In these comments, the Advanced Television Broadcasting Alliance ("ATBA")[1] responds to matters raised in the May 20 *Public Notice*[2] in the above-captioned dockets.

ATBA appreciates the Incentive Auction Task Force's ("IATF") release of the results of scenario analyses that provide a glimpse into the IATF's consideration of issues related to selection of an initial clearing target, a budget for impairments, and assignment of some repacked broadcast stations to channels in the post-auction wireless band. However, the small amount of information released and the absence of any stated purpose for the release raise more questions than they answer. ATBA and other commenters are entitled to more transparency into the Commission's plans for the auction. Scenarios modeling nominal impairment budgets that do not account for interference from Mexican stations are simply misleading.

[1] ATBA members include licensees, owners and operators of hundreds of low-power television ("LPTV") and translator stations, full power television broadcasters, and allied industry organizations and companies.

[2] *Incentive Auction Task Force Releases Clearing Target Optimization Simulations*, Public Notice, AU Docket No. 14-252, GN Docket No. 12-268, DA 15-606 (rel. May 20, 2015) ("*Public Notice*").

What scant information is provided in the *Public Notice,* in context of other available information, strongly supports the selection of 84 MHz as the highest clearing target the FCC should pursue. And regardless of the clearing target, the FCC should reject all approaches that would result in systematic assignment of television stations to the post-auction wireless band and elimination of LPTV and translator stations without any accounting of the loss of service.

I. Summary

Upon first reviewing the *Public Notice* ATBA was initially (if cautiously) encouraged that the IATF appeared to be considering options other than the proposal in the *Auction 1000 Comment PN*[3] to pre-ordain weighted impairments of 20 percent nationwide before the FCC knows which stations, or even how many stations, in each geographic area will participate in the auction.

But the encouragement was short-lived. On closer review, rather than providing much-needed transparency into the Commission's decision making process, the *Public Notice* further obscures that process by publishing scenario results that are meaningless at best and misleading at worst. And by suggesting that the Commission may be considering impairments that are even greater than the 20 percent weighted cap previously proposed, the *Public Notice* suggests the Commission may be considering elimination of even more broadcast voices in pursuit of an unrealistically high clearing target.

ATBA does not understand the purpose of the *Public Notice* and can only draw vague inferences about what the *Public Notice* means in this rulemaking process or how it may affect the rules that will apply in the auction. The scenarios modeled, as described in the *Public Notice,* do not simulate the approach proposed by the FCC in the *Auction 1000 Comment PN*. Instead, in

[3] *Comment Sought on Competitive Bidding Procedures for Broadcast Incentive Auction 1000, Including Auctions 1001 and 1002*, Public Notice, 29 FCC Rcd 15750 (2014) ("*Auction 1000 Comment PN*" or "*Comment PN*").

response to unspecified comments, the IATF's simulations analyzed clearing targets based on a "modified" impairment methodology that the Commission has only superficially explained and which has not been proposed as a rule for the auction.[4]

The *Public Notice* makes no proposals, asks no questions, and explains nothing of the role (if any) the new scenarios (or other information developed by the staff but not made available to the public) will play in setting the rules of the auction. But the very release of the *Public Notice* implies that the scenarios *are* playing some significant role in guiding the FCC's decision making. ATBA finds this troubling, since the *Public Notice* reveals that, years into the auction planning process, *the FCC still does not know the degree to which television stations in Mexico will impair license blocks in the United States*. This is a fatal flaw for an analysis that purports to assess various impairment scenarios. An impairment "budget" of 14 percent or even 20 percent at least tells *something* of what the Commission may do (or permit its auction software to do). But a budget of 14 percent plus *x*—where the value of *x* is unknown—tells no more than if the *Public Notice* had simply stated that the budget is *x*.

The *Public Notice* also appears to confirm that that the Commission, or at least the IATF, is continuing to pursue artificially high spectrum clearing targets that will wreak havoc on television broadcasters and their viewers, and for no good reason. Artificially high clearing targets will lead to the displacement and likely elimination of hundreds of LPTV and translator stations above and beyond those that would be displaced and eliminated if the FCC were to adopt a pragmatic spectrum clearing target. And (at least as proposed in the *Auction 1000 Comment PN* and (apparently) as reflected in the *Public Notice*), they will inevitably result in stranding

[4] *See Public Notice* ¶ 2 ("Instead of accommodating impairments up to 20 percent, the simulations apply a standard of up to (but not equal to) the equivalent of one license block nationwide, as measured by weighted population ('weighted-pops')").

many television stations in the post-auction wireless band and/or the wireless band's duplex gap in border areas, markets with high population density, and potentially anywhere in the country. The collateral damage will be enormous. The FCC cannot meet its obligations under the Administrative Procedures Act ("APA") and the Communications Act without assessing and quantifying that damage and weighing it against the vastly diminishing returns when the clearing target exceeds 84 MHz.

The Commission should release all of the assumptions and source data behind the scenarios modeled and summarily reported in the *Public Notice,* and should also release the same data about other scenarios it has run. And if it has not done so, it should run all scenarios it is considering for *all clearing targets the FCC will permit*, including the lowest clearing targets (42, 48 and 60 MHz) to the highest (including 138 and 144 MHz).[5] Those scenarios should reflect the likely impact of each clearing target under various assumptions on all of the major licensed services directly affected by the choice of clearing target. The FCC cannot consider only the impact of the choice of clearing target on the forward auction winners. It must also consider the negative impacts on full power broadcast stations that are stranded out-of-core and on the number of LPTV and translator stations that would be eliminated with little chance of finding displacement channels.

Doing so would not be burdensome. The number of possible clearing targets is limited: the FCC has proposed just eleven.[6] Given the sweeping impact of the auction on the nation's telecommunications and media infrastructures and services, it is inconceivable that the Commission would proceed without quantifying the impact on licensed services at each of the

[5] *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Report and Order, 29 FCC Rcd 6567, 7018-025 (2014).

[6] *Id.*

eleven clearing targets.[7] And absent extraordinarily compelling reasons to do otherwise (*i.e.,* far greater participation by broadcasters than the FCC's high end projections as reflected in the scenarios modeled), based on the information available to date, the Commission should plan for and pursue 84 MHz as the high end clearing target.

II. The May 20 *Public Notice* Does Not Enable Parties to Meaningfully Comment

The stated intent of the *Public Notice* is to "provide[] the results of several staff simulations of the initial clearing target optimization procedure" run in response to comments submitted in this proceeding.[8] But the *Public Notice* does not say which comments occasioned the new modeling, and provides only superficial information about the assumptions and methodology used in modeling the scenarios. It is clear, though, that the IATF continues to pursue a clearing target that is as high as possible. Given that many of the parties most affected by the proposal to *mandate* a high level of impairment before the auction even starts submitted comments criticizing and objecting to that approach, one might expect the Commission to seek comment on options that would *reduce* the level of impairment. But the scenarios reflected in the *Public Notice* could, and in some cases would be certain to, *materially increase* the degree of impairment versus the 20 percent budget, which itself is unjustified and far too great.

How will the IATF and the FCC use the results of the scenarios outlined in the *Public Notice* and the comments submitted in response? And how, if at all, do those scenarios change the tentative conclusions the FCC reached in paragraphs 24 through 45 of the *Auction 1000 Comment PN*? It is not clear from the four corners of the *Public Notice* that either the IATF or the Commission intends to use the comments at all. And reliance on the scenarios outlined in the

[7] *Id.*

[8] *Public Notice* ¶¶ 1-2.

Public Notice itself would be reckless. Although the *Public Notice* reveals very little about the assumptions and methodology behind the summary reports published, it does state that "the simulations do not reflect any interference from Mexican TV stations into the United States"[9] because (less than a year before the start of the auction) the FCC has "insufficient data" to account for the interference. This failure to account for interference from Mexican TV stations is particularly troubling because the *Public Notice* acknowledges that "including the predicted interference from Mexican stations **would** increase the impairment level in each of the scenarios."[10]

The failure to account for interference from stations in Mexico is even more troubling for what it reveals about the reliability of the tools the FCC plans to use to conduct the auction and the status of the FCC's coordination (or lack thereof) with Mexico less than a year before the auction is planned to commence. Some basic information about authorized and operating television stations in Mexico should be publicly available, and certainly should be at least discoverable by the FCC, even outside of actual coordination efforts. In any case, AT&T has run its own study of the Mexico impairments and filed the results in this docket five weeks before the FCC issued the Public Notice.[11] Using data regarding stations in Mexico that AT&T found in the FCC's own *TVStudy* software, AT&T calculated 8.3% nationwide impairment from those stations at a 126 MHz clearing level, and 7.5% impairment for clearing of 84 MHz.[12]

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[9] *Public Notice* ¶ 3.

[10] *Id.* ¶ 3 n.10 (emphasis added).

[11] *See Ex Parte* Letter from Michael Goggin, AT&T, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 12-268 (filed Apr. 14, 2015) ("AT&T *Ex Parte*") at Slide 4 ("[a]nalysis considers non-US stations in Mexico and Canada as recorded in *TVStudy* database including vacant and active TV stations allotments").

[12] *Id.*

Yet the *Public Notice* does not even acknowledge AT&T's filing, even when stating that the IATF did not account for interference from stations in Mexico due to "insufficient data".[13] This should raise red flags. If *TVStudy* (which the Commission adopted after public comment) includes critical source data that the IATF chose not to use in scenario modeling (which has also been placed for public comment) because the IATF considers the *TVStudy* data to be inadequate to the task of modeling impairments, how can that same data be used to generate a repacking plan? And if the FCC wishes to change the source data, is the FCC not required to seek comment on those changes? The FCC cannot trust the data it has about allotments in Mexico for purposes of making permanent assignments to broadcaster while rejecting the very same data as too inaccurate to use in hypothetical scenario modeling.

Does the FCC plan to make critical decisions impacting virtually all Americans and perhaps half or more of all television stations without ascertaining basic facts that are essential to quantifying the auction by the "impaired blocks" measuring stick the FCC itself contrived? Although the *Public Notice* states that the IATF "anticipate[s] the Commission will have the data necessary to make these calculations in advance of the incentive auction", there is no commitment to release that data sufficiently far in advance of the auction to permit meaningful comment. In the meantime, it appears that the Commission is designing its most complex auction ever around a material unknown variable, while using information it believes to be flawed or incomplete for purposes of repacking.

Many spectrum blocks that the *Public Notice* counts as unimpaired will, in reality, be impaired—if useable at all. Because the *Public Notice* concedes that accurate data might guide different policy decisions, the FCC cannot adopt rules later based on accurate data without

[13] *Public Notice* at ¶ 3.

seeking comment on the rules when accurate data is available to inform those comments. The *Public Notice's* lack of transparency inhibits ATBA's (and other interested parties') ability to meaningful comment on the reports. For example, if the IATF does in fact have data to support its statement that Mexican TV stations "would increase the impairment level," ATBA asserts that the FCC should release that information to the public to enable potential auction participants to make the informed decisions required to achieve a successful auction. Additionally, the FCC appears to have made certain assumptions about station participation without disclosing what those assumptions were, or the data used to reach them. Without this information, the ATBA cannot evaluate the data or substantively comment on the simulations.

ATBA is concerned that the scenarios reflected in the *Public Notice*, including the presumed (yet unstated) proposal to adopt a "single weighted block" equivalent impairment for all auction clearing targets, if adopted by the Commission, may under many scenarios make matters far worse than the weighted 20 percent budget the FCC has already proposed. But the limited amount of information released makes it impossible to tell how these two alternatives compare. And the challenge of providing meaningful comment is compounded by the fact that the FCC never explained how it chose the weighted 20 percent threshold proposed in the *Auction 1000 Comment PN* in the first place, and appears never to have assessed the tradeoffs in public interest benefits and detriments arising from that proposal. As others have noted[14], the proposed 20 percent weighted impairment mandate appears to be entirely arbitrary.

Now, instead of providing data, analysis and rationales that were notably missing from the proposal to accept (and actually mandate) a certain level of impairment generally or the

[14] *See, e.g.*, *Competitive Bidding Procedures for Broadcast Incentive Auction 1000, Including Auctions 1001 and 1002, Expanding the Economic and Innovation Opportunities of Spectrum through Incentive Auctions*, AU Docket No, 14-252, GN Docket No, 12-268, Comments of AT&T at 23 (filed Feb. 20, 2015) ("Comments of AT&T").

proposed 20 percent weighted impairment specifically, the *Public Notice* provides extremely limited information about some possible impacts of an entirely different approach, albeit still one that mandates a high level of impairment. The *Public Notice* simply muddles a rulemaking process that was already far too murky. Whatever the FCC concludes about the authority Congress granted it under the Spectrum Act of 2012, Congress did not grant the FCC a dispensation from the basic requirements of notice and comment rulemaking or, as discussed below, its longstanding obligations under the Communications Act.

III. The FCC Should Establish a High End Clearing Target of 84 MHz and Pursue a Truly Near-Nationwide Band Plan.

ATBA opposes any approach to setting an artificially high clearing target. By "artificially high" we mean a clearing target that cannot be achieved without systematically assigning broadcast stations out-of-core (in the post-auction wireless band, duplex gap or guard bands) in repacking. Other commenters have explained at length why systematic assignment of broadcast stations to the post-auction wireless band is a bad policy choice for the incentive auction.[15] But to date, the FCC has failed to meaningfully respond to those objections, and the *Public Notice* strongly suggests that the Commission intends to proceed with a highly variable approach to produce an artificially high clearing target. And more troubling to ATBA, the FCC has refused to quantify the impact of a highly variable band plan with a high nominal clearing

[15] *See, e.g.*, Comments of AT&T at 2-3 ("placing a high power broadcast TV station in the 600 MHz wireless band can destroy spectrum value in other geographies and frequencies and, therefore, [] maximizing the number of licenses offered in the forward auction by allowing substantial "market variation" will compromise both auction revenue and the social value obtained from the spectrum resource."); Reply Comments of the National Association of Broadcasters, AU Docket No, 14-252 GN Docket No, 12-268, at 2, (filed Mar. 13, 2015) ("The record is replete with comments asserting that repacking television stations in the 600 MHz wireless band complicates the auction and introduces unnecessary risk."); Comments of the Public Broadcasting Service et al., AU Docket No, 14-252, GN Docket No, 12-268, at 2-5 (filed Feb. 20, 2015) ("CTIA, for instance, has expressed concerns about the burdens wireless carriers would have to bear to avoid causing any interference to TV stations in the 600 MHz Band. And if television stations are assigned within the uplink band, it is unclear how stations could practically enforce their protections against interference caused by consumers' mobile devices.").

target on LPTV and translator stations and the viewers who rely on them. The FCC should and must correct this error.

In passing the Spectrum Act of 2012 Congress authorized the FCC to conduct the first ever incentive auction of broadcast television spectrum. But the FCC cannot plan and conduct the auction in procedural and policy vacuums. Nothing in the Spectrum Act exempts the FCC's adoption of auction rules or its conduct of the auction itself from the mandates of the APA or the Commission's obligations under the Communications Act. Its obligations under the APA require far more disclosure of the rationales behind the FCC's proposals and some effort to assess the pros and cons of alternatives.

ATBA does not suggest that the FCC has to consider every possible alternative to its ultimate decision; however, its "cursory rejection of an option that appears to serve precisely the agency's purported goals suggests a lapse of rational decisionmaking." [16] And, it is well established that the APA requires an agency engaged in rulemaking to "examine[] the relevant data and articulate[] a satisfactory explanation for its action, including a 'rational connection between the facts found and the choice made.'"[17]

To date, the FCC has not articulated a rational justification for its proposal to accommodate an initial impairment cap of 20 percent and to set a clearing target of 126 MHz. Indeed, the main beneficiaries of a nominal 126 MHz clearing target that results in impaired or unauctionable blocks throughout the border regions and potentially across the country appear to be advocates of more spectrum for unlicensed use, and bidders eligible to acquire the unimpaired reserved blocks. But the burden of that policy choice falls most heavily on the hundreds of

[16] *Achernar Broad. Co. v. F.C.C.*, 62 F.3d 1441, 1447 (D.C. Cir. 1995).

[17] *Prometheus Radio Project v. F.C.C.*, 373 F.3d 372, 389-90 (3d Cir. 2004) (holding that the FCC did not support its decision to retain existing numerical limits with reasoned analysis).

LPTV and translator operators who will lose their licenses with little chance of displacement, and the full power broadcasters that end up in the wireless band.

One of the biggest problems with a variable band plan is the temptation to push it too far. As conceived, the variable band plan should permit the FCC to repurpose the amount of spectrum both demanded for wireless use and capable of being cleared on a near-nationwide basis, without limiting the entire country to the spectrum available in the most constrained market or couple of markets. But pushed too far, a variable band plan becomes a mechanism to reclaim more spectrum where it is available, simply because variability allows the FCC to make it available, without regard to demonstrated demand or any nationwide coherence. Because both television stations and wireless services are clustered in the areas of greatest population density, the areas in which more spectrum is naturally available or easily obtained correspond almost directly to areas in which there is less demand for additional wireless spectrum. So the FCC's flexible weighted impairment approach will result in more spectrum being reclaimed where it is needed least, or not needed at all for wireless service. In many cases these will include the small communities that rely disproportionately or exclusively on translators and LPTV stations.

The *Public Notice* betrays an apparent intention to push variability too far. The Commission should permit some limited variability if needed, but should not permit variability anywhere near the extent reflected in the 20 percent weighted budget or the possibly far higher extent considered in the *Public Notice.* This is particularly true in light of substantial evidence that "there is a high likelihood that the auction will clear at least 84 MHz of spectrum nationwide without the need for placing TV stations in the 600 MHz band, and certainly without the need to place so many TV stations there that 20 percent (or more) of the population would be

impaired."[18] Certainly, the FCC cannot mandate a high level of variability when a large, uniform, reallocation of 84 MHz is achievable, without carefully weighing what is to be gained against the enormous cost of variability. And the costs are enormous. FCC records reflect that approximately 750 LPTV and translator stations operate in the channels below Channel 37 that would be repurposed in a 126 MHz scenario. All or essentially all of those stations would be displaced in addition to the stations above Channel 37 that will be displaced with an 84 MHz target. This means far more LPTV and translator stations will be competing for far fewer displacement channels, leading to a far greater loss of broadcast service. Although the FCC may have the authority to displace LPTV stations in order to effectuate repacking, nothing in the Spectrum Act of 2012 or elsewhere absolves the FCC of its general obligations under the Communications Act.

For decades, the Commission has repeatedly recognized the benefits that LPTV stations provide to the public.[19] Ever mindful of the Communications Act's "longstanding broadcast policy goals of diversity and encouraging new entry, particularly for minorities and women," the FCC has noted that "LPTV stations have increased the diversity of television programming and station ownership, and serve many rural and urban ethnic communities."[20] Further, "TV

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[18] *Competitive Bidding Procedures for Broadcast Incentive Auction 1000, Including Auctions 1001 and 1002, Expanding the Economic and Innovcation Opportunities of Spectrum through Incentive Auctions,* AU Docket No, 14-252, GN Docket No, 12-268, Reply Comments of AT&T at 17 (filed Mar. 13, 2015). AT&T correctly points out that, "[a]mong the commenters addressing the issue, there is near unanimous agreement that placing TV stations in the 600 MHz band plan would result in a nationwide patchwork of spectrum subject to varying amounts of impairment that can only undermine the success of the auction."

[19] *See, e.g.*, *Advanced Television Systems and Their Impact Upon the Existing Broadcast Service*, Sixth Report and Order, 12 FCC Rcd 14588, 14591-92 ¶ 6, (1997); *Advanced Television Systems and Their Impact Upon the Existing Broadcast Service*, Sixth Further Notice of Proposed Rulemaking, 11 FCC Rcd 10968, 10995-996 ¶ 67 (1996) ("6th FNPRM").

[20] 6th FNPRM at 10995-996, ¶ 67.

translators are used to provide TV service to communities located in areas of mountainous terrain and to provide 'fill-in' service to shadowed areas within a full service stations service area."[21]

But now, contrary to the Communications Act's mandate to make broadcast service "available, so far as possible, to all the people of the United States,"[22] the FCC's proposal will shut down service that Americans all over the country rely on without even acknowledging, let along justifying, the harm that will result. The record reflects no data or projections regarding (or any FCC interest in) the number of viewers who would lose access to over the air broadcast service, in whole or in part, through elimination of LPTV and translator stations. In failing to meaningfully consider options supported by the record and in the public interest, the FCC appears to be giving "short shrift to certain of its statutory obligations" in "its zeal to promote new technology."[23] Commenters can debate how the FCC should weigh unnecessary elimination of broadcast service against other goals of equal statutory prominence the FCC may wish to pursue. But the FCC cannot refuse to quantify the loss of service it would cause and weigh that loss against other policy goals.

The existence of a natural guard band at channel 37 is yet another factor in favor of setting the initial clearing target at 84 MHz. Any clearing target above 84 MHz not only needlessly eliminates LPTV and translator stations, but also yields substantially diminishing returns in the forward auction. Charles Rhodes has explained the diminishing returns in an article published by TVTechnology,[24] and illustrated his analysis with this figure:

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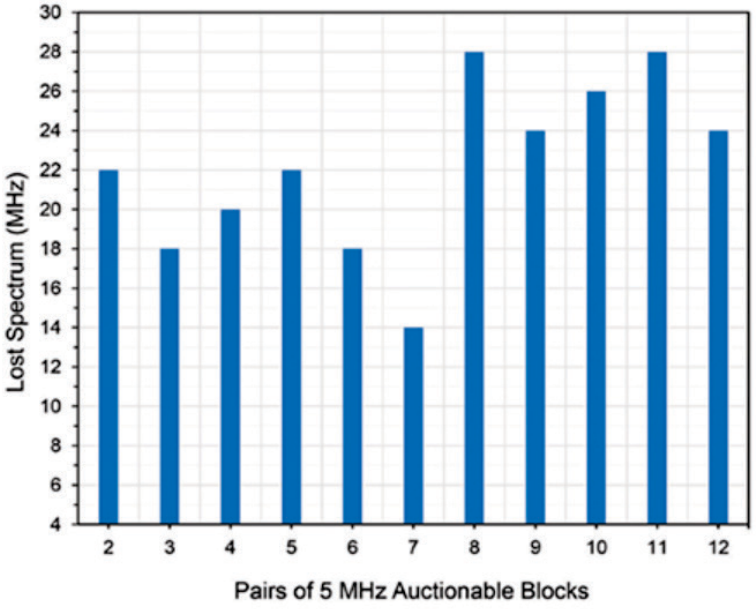
[21] *Id.*

[22] 47 U.S.C. § 151.

[23] *See Nat'l Ass'n of Broadcasters v. F.C.C.*, 740 F.2d 1190, 1195 (D.C. Cir. 1984).

[24] *See* Charles W. Rhodes, *Eleven FCC Scenarios for The 600 MHz Band Plan*, TVTECHNOLOGY.COM, http://tvtechnology.com/digital-tv/0148/eleven-fcc-scenarios-for-the--mhz-band-plan/274384 (last accessed June 3, 2015). A printout of the article is attached as Exhibit A.



The chart illustrates "Lost UHF Band Spectrum" in MHz as a function of the number of pairs of 5 MHz blocks available for auction. There is a steep increase in "Lost Spectrum" between 7 pairs and 8 pairs of 5 MHz auctionable blocks. An 84 MHz auction yields 70 MHz of auctionable spectrum. Adding another 10 MHz—one more block—requires the FCC to clear broadcasters from an additional 24 MHz, or 4 channels of spectrum.

Although the FCC may take the position that it is not required to protect LPTV and translator stations in the auction, the FCC is not authorized to eliminate television service, particularly in areas of lower demand for wireless spectrum, without at the very least quantifying the impact of its decision. It must identify what it is sacrificing and what valid policy goals it is achieving in return, and must seek comment on those proposed tradeoffs.

IV. Conclusion

In sum, the *Public Notice* does not provide sufficient information for parties to meaningfully assess the Commission's proposals. And as noted above, it even raises new questions—questions that must be addressed and resolved well before the auction—about the

reliability of *TVStudy* for making repacking assignments. But to the extent the *Public Notice* confirms the Commission's intention to accept a very high level of weighted impairments (which almost certainly understates the actual level of impairment caused), ATBA objects. The FCC should aim for a coherent, nationwide band plan, and should not *intentionally increase* impairments by assigning broadcast stations to the wireless band or the duplex gap. The FCC should do all it reasonably can to *minimize* impairments.

While the Spectrum Act does not mandate a specific clearing target and may not directly obligate the FCC to protect LPTV and translator stations in all circumstances, the APA and Communications Act require the FCC to "articulate a satisfactory explanation" before displacing a substantial number of LPTV and translator stations, the public benefits of which have long been recognized by the Commission. Accordingly, the ATBA respectfully requests that the Commission (1) provide parties with more information about all simulation results and assumptions made, (2) provide a full set of data, including assumptions and simulation results, for each of the eleven clearing targets, and (3) absent highly compelling justifications to the contrary (such as broadcaster participation far greater than presently anticipated), establish an initial high end clearing target of 84 MHz.

Respectfully submitted,

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June 3, 2015

EXHIBIT A

TVTechnology

Print Page

Eleven FCC Scenarios for The 600 MHz Band Plan

2/17/2015

Charles W. Rhodes

The FCC is proposing 11 scenarios for a 600 MHz Band Plan following the spectrum auctions. Which of these will be adopted will be determined by the outcome of the auction in 2016.

Each scenario for the 600 MHz band starts with Channel 21 (512–518 MHz). The highest channel number ranges from 26 to 44, depending on how much spectrum is offered for sale by broadcasters and then resold to broadband operators. The re-allocated spectrum is divided into blocks of 5 MHz each. There could be from two to 12 pairs of blocks. Pairs consist of one block for uplink transmissions from cellphones to base stations; and a second for downlink transmission by base stations to cellphones.

INTER-SERVICE INTERFERENCE

I have restructured the data in Fig. 1 into Figs. 2 and 3. Fig. 2 shows the number of UHF TV channels after repacking. It varies from 6 to 23 depending on how many pairs of 5 MHz blocks are re-allocated after the auction.

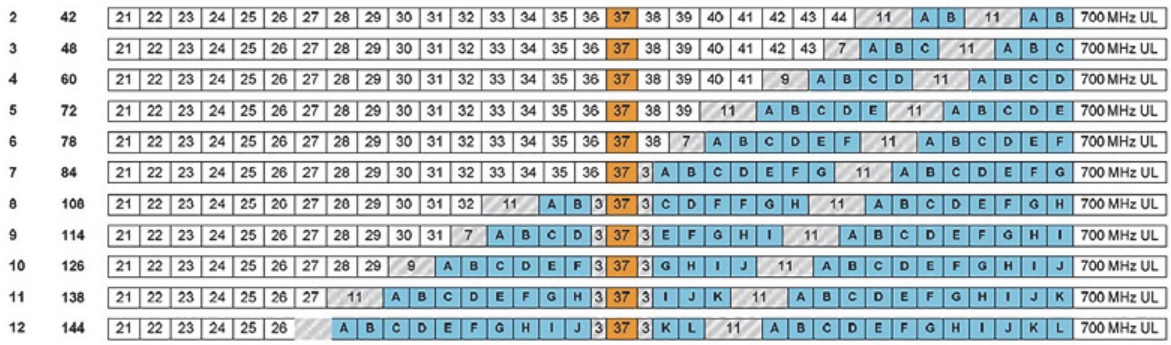

Fig. 1: The graph is Fig. 23 of the FCC's June 2 R&O, page 453. Light Blue: 5 MHz blocks of spectrum. Orange: Channel 37 reserved for radio astronomy and medical telemetry (hospitals). Diagonally shaded gray: guard bands. Blocks with numbers from 21–36 and 38–44 should be tinted light green. These are the remaining DTV channels. The numbers in a column on the left side are the amounts of spectrum broadcasters might offer to sell. The amount of spectrum that can be re-sold to broadband is less due to the need for guard bands in the 600 MHz band.

In Fig. 1, the striped cells with numbers of MHz; 11, 9, 7 or 3 represent the guard bands. There is an 11 MHz-wide guard band between the cellphone uplink blocks and the base station downlink blocks. There are also some smaller guard bands, notably, a 3 MHz-wide one adjacent to Channel 37; and a 7 MHz-wide guard band between some base station transmit blocks and DTV channels.

These guard bands are vital to protecting against what the FCC calls "Inter-Service Interference" or ISIX. Broadcasters are familiar with the fact that a DTV transmitter radiates power in both channels adjacent to the channel it is licensed to use. This is sometimes called sideband splatter, but it is actually third-order inter-modulation products generated in the high-power amplifier of a DTV transmitter; which gets past the transmitter RF mask filter and is radiated.

The 3 MHz guard bands on either side of Channel 37 (608-614 MHz), which is reserved for radio astronomy and medical telemetry, protect that channel from ISIX. The total bandwidth of all guard bands varies among the 11 FCC scenarios from 14 MHz to 28 MHz. I call such spectrum "lost" because, by definition, it cannot be used either by broadcasters or sold to broadband. Such spectrum is also lost as a source of revenue to the U.S. Treasury Department.

BEST LAID PLANS

I expect there will be pressure by white space advocates to let these guard bands also be used for white space services. That scares me because I recall the "good ol' days" of Citizen's Band mobile radios. Chaos soon reigned in the CB Band.

If the FCC chooses either eight or 11 pairs of 5 MHz blocks, it will have to purchase 28 MHz more spectrum from broadcasters than it will be able to resell to broadband operators. Since the commission is mandated not to lose money in these auctions, it will have to resell this spectrum at a price well above what it paid for the spectrum it purchased from broadcasters.

The 2012 law that authorized this auction requires the FCC to recover all costs of conducting it and requires the commission to turn over to the U.S. Treasury the net profits. I believe some of the billions of dollars expected from this spectrum auction

will never be realized. I suspect that the estimated $44 billion of auction proceeds do not take into account the fact that some spectrum the FCC will buy cannot be resold because it must be used as guard intervals in the 600 MHz band plan.

The best case scenario from this perspective would have the FCC buy 84 MHz of spectrum and to resell 70 MHz of this spectrum. The minimum markup would be 84/70 or 20 percent. Administrative costs, the $1.75 billion to reimburse displaced broadcasters, and the profit for the U.S. Treasury will erode those billions of dollars promised to Congress.

Fig. 3 plots the number of DTV channels in the 600 MHz band after repacking as a function of the number of pairs of 5 MHz blocks auctioned by the FCC. The outstanding feature of this plot is the steep decline in the number of DTV channels between the scenario with seven pairs of 5 MHz blocks (16 DTV channels) and the scenario with eight pairs of 5 MHz blocks. It would cost broadcasters four channels to allow one additional pair of 5 MHz blocks instead of seven pairs.

When all is said, it appears the best scenario identified by the FCC would provide seven pairs of 5 MHz blocks. This view has also been expressed by a number of cellphone operators according to the FCC.

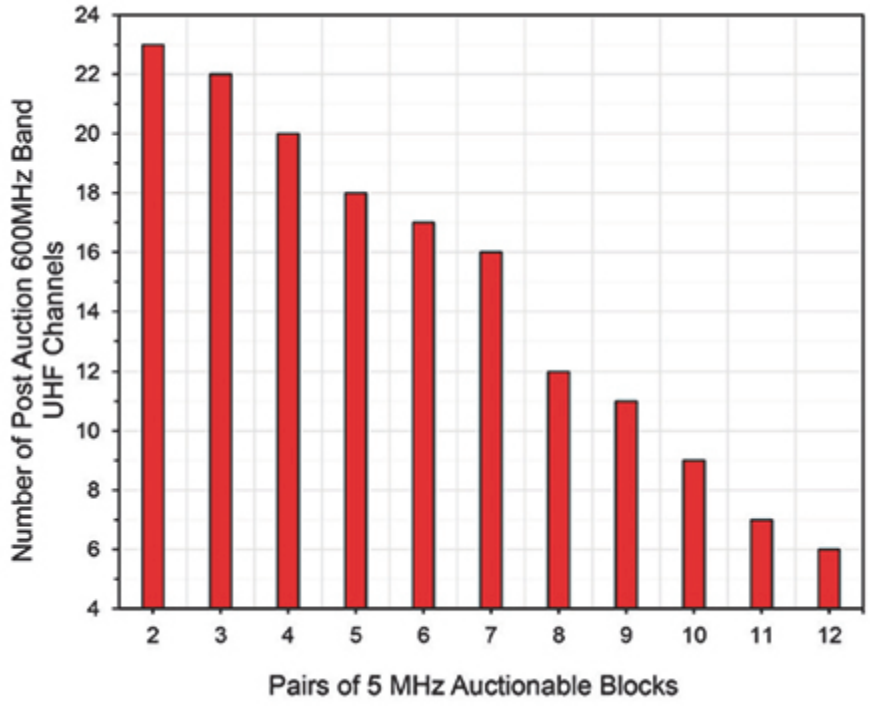

Fig. 2: Number of DTV channels after repacking as a function of the number of pairs of 5 MHz blocks available for auction.

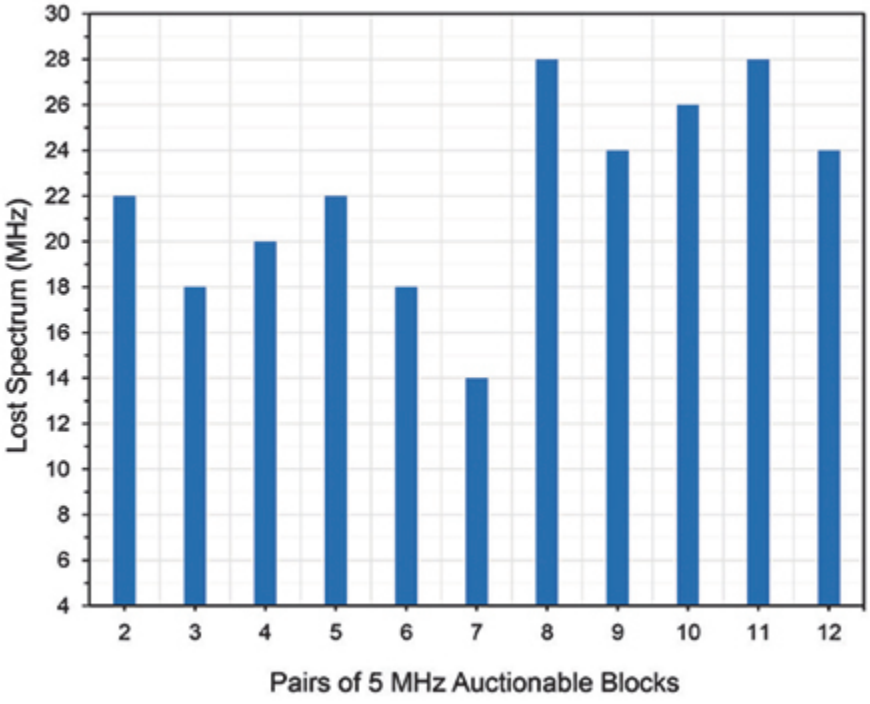

Fig. 3: "Lost UHF Band Spectrum" in MHz. as a function of the number of pairs of 5 MHz blocks available for auction. Note the steep increase in "Lost Spectrum" between 7 pairs and 8 pairs of 5 MHz auctionable blocks.

CELLPHONE DESIGN

The FCC report provides a very complete analysis of each of the 11 scenarios depicted in Fig. 1 (FCC 14–50, p. 453). As Fig. 1 shows, there are guard bands of 3, 7, 9 and 11 MHz between different kinds or signals. The 11 MHz guard bands between uplink and downlink signals are obviously needed to keep the transmitter output from getting into the receiver input. The others are also required to avoid third-order distortion products from causing interference. For example, the 3 MHz band stop filters keep received signals in Channels 36 or 38 out of Channel 37.

Every kind of filter attenuates every signal within its pass band (insertion loss). With each 1 dB of insertion loss, the receiver's noise figure increases by 1 dB, and sensitivity decreases by 1 dB. Worse yet, where there is more than one filter in the signal path, the insertion loss of each filter is additive. In Fig. 1, you will see that each scenario requires at least one 11 MHz filter and some require two or three filters. Filters not only cost in receiver performance, they cannot be manufactured as an integrated circuit so they take up space and add slightly to the weight of handheld cellphones. The fewer the number of filters in a handheld cellphone, the less it will cost and weigh, all things cellphone users can appreciate. As Fig. 1 shows, the number of filters varies significantly for the various scenarios.

There is yet another variable of importance not shown in Fig. 1, but was covered in the FCC report. The bandwidth over which the antenna of a handheld cellphone is efficient varies between the scenarios in the FCC Plan for the 600 MHz Band. Antenna efficiency directly affects battery life (time between recharges), as well as the sensitivity of the receiver. Scenarios that provide more than eight pairs of 5 MHz blocks will involve these antenna bandwidth problems. Where the efficiency of a simple passive antenna is poor (lots of signal bandwidth), the antenna can be automatically tuned to improve its efficiency. However this automatic antenna tuner feature requires added circuitry and therefore adds to the manufacturing cost. The insertion loss of this reduces the power to the antenna, which translates to increased power drain on the battery when transmitting. When receiving, it adds desensitization of the received signal.

Stay tuned.

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