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

In the Matter of	)	
	)	
Office of Engineering and Technology	)	ET Docket No. 14-14
Seeks to Supplement the Incentive Auction	)	
Proceeding Record Regarding Potential	)	
Interference Between Broadcast Television	)	
And Wireless Services	)	
	)	
Expanding the Economic and Innovation	)	GN Docket No. 12-268
Opportunities of Spectrum Through	)	
Incentive Auctions	)	

COMMENTS OF THE NATIONAL ASSOCIATION OF BROADCASTERS, ABC TELEVISION AFFILIATES ASSOCIATION, FBC TELEVISION AFFILIATES ASSOCIATION, CBS TELEVISION NETWORK AFFILIATES ASSOCIATION, NBC TELEVISION AFFILIATES, THE ASSOCIATION OF PUBLIC TELEVISION STATIONS, THE CORPORATION FOR PUBLIC BROADCASTING, AND THE PUBLIC BROADCASTING SERVICE

March 18, 2014

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Executive Summary

The National Association of Broadcasters ("NAB"), ABC Television Affiliates Association, FBC Television Affiliates Association, CBS Television Network Affiliates Association, NBC Affiliates Television Affiliates, the Association of Public Television Stations, the Corporation for Public Broadcasting, and the Public Broadcasting Service (collectively, the "Joint Broadcasters") maintain that the most effective incentive auction band plan is one that is nationwide and does not vary by market. By employing variability, the FCC is introducing additional complexity into the auction process and the risk of interference between wireless and broadcast services increases exponentially. In our view, it is not a risk worth taking.

If the FCC believes it imperative to use a variable band plan, it is essential that the Commission not cut corners, but rather ensure that there will be no harmful interference between broadcast and wireless operations. While we understand that the Commission does not want to be overly conservative in its interference predictions, the Commission is playing with fire if it attempts to underestimate interference at each juncture. If not done properly, the variable band plan could lead to years of interference disputes between broadcasters and wireless carriers that will dwarf the interoperability challenges the Commission has faced since the 700 MHz auction in 2008. Moreover, the Spectrum Act requires that any model of interference between services preserve the coverage areas and populations served of televisions stations that remain on the air.

Unfortunately, the methodology set forth in the January 29, 2014 *Public Notice*[1] by the Office of Engineering Technology ("OET") runs afoul of the Spectrum Act and will produce significant interference between broadcast and wireless services across the country. OET's proposed methodology relies on a number of inaccurate assumptions and inputs. Virtually every decision OET has made in developing its methodology appears to have been selected to direct the outcome towards shorter separation distances even where inter-service interference is likely to occur. Among other things, OET's proposal:

- assumes operating parameters for wireless base stations that are significantly reduced from the Commission's proposed service rules, and inconsistent with available facts concerning actual deployments;
- ignores combined interference contributions from multiple wireless base stations;
- makes questionable assumptions concerning the interference potential for LTE emissions without testing to confirm such assertions;
- makes unprecedented use of inappropriate field strength prediction characteristics that understate the potential for inter-service interference; and
- selectively uses clutter loss in predicting interference to television service from wireless transmissions.

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[1] *Office of Engineering and Technology Seeks To Supplement The Incentive Auction Proceeding Record Regarding Potential Interference Between Broadcast Television And Wireless Services*, Public Notice, ET Docket No. 14-14, GN Docket No. 12-268, DA 14-98 (rel. Jan. 29, 2014) ("*Public Notice*").

Beyond the methodological missteps, the *Public Notice* is the latest in a string of procedurally deficient FCC actions that contravene the requirements of the Spectrum Act[2] and the Administrative Procedure Act ("APA").[3] Despite announcing repeated proposals to change aspects of the methodology for evaluating interference between television stations,[4] and now between television stations and wireless services, OET has never adequately explained how these proposals comport with Section 6403(b)(2) of the Spectrum Act, which establishes the standard for measuring television stations' coverage areas and populations served as of the date of the Spectrum Act. OET also has failed to provide sufficient detail concerning the precise changes that are contemplated and thus has not offered meaningful opportunities for affected parties to comment on those changes. The *Public Notice* continues this trend by offering only vague signals about the methodological changes that OET is considering, and thus continues to deprive stakeholders like NAB of adequate notice of those changes and opportunity to provide meaningful comment on their effects. This approach is arbitrary and capricious.

The Joint Broadcasters believe that the Commission should adopt a different approach to predicting inter-service interference. *First*, the Commission should select a band plan that minimizes the potential for inter-service interference. The auction cannot be a success if what results is lost service for television viewers and wireless broadband consumers. *Second*, the Commission should employ a far simpler, more balanced methodology for predicting interference that will align more closely with the post-auction

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[2] *See* Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. 112-96, 126 Stat. 156, § 6403(b)(2) (Feb. 22, 2012) (codified at 47 U.S.C. § 1452(b)(2)) ("Spectrum Act").

[3] *See* 5 U.S.C. § 553.

[4] *See Office of Engineering and Technology Releases and Seeks Comment on Updated OET-69 Software*, Public Notice, ET Docket No. 13-26, GN Docket No. 12-268, DA 13-138 (Feb. 4, 2013) ("*TVStudy* Proceeding").

interference environment broadcasters and wireless operators will face. Not only will this avoid post-auction interference challenges at least as serious as we have seen with 700 MHz, but also providing wireless bidders with greater certainty that they actually will be able to deploy networks using spectrum they won at auction will increase bidding in the forward auction.

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The National Association of Broadcasters ("NAB"),[5] ABC Television Affiliates Association, FBC Television Affiliates Association, CBS Television Network Affiliates Association, NBC Affiliates Association,[6] the Association of Public Television Stations,[7]

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[5] The National Association of Broadcasters is a nonprofit trade association that advocates on behalf of free local radio and television stations and broadcast networks before Congress, the Federal Communications Commission and other federal agencies, and the courts.

[6] Each of the ABC Television Affiliates Association, FBC Television Affiliates Association, and NBC Television Affiliates is a non-profit trade association whose members consist of local television broadcast stations throughout the county that are affiliated with its respective broadcast television network.

[7] The Association of Public Television Stations is a non-profit organization whose membership comprises the licensees of nearly all the nation's Corporation for Public Broadcasting qualified noncommercial educational television stations. The APTS mission is to support the continued growth and development of a strong and financially sound noncommercial television service for the American public.

the Corporation for Public Broadcasting,[8] and the Public Broadcasting Service[9] (collectively, the "Joint Broadcasters") submit these comments in response to the *Public Notice* seeking comment on a methodology for predicting potential interference between broadcast television and licensed wireless services following the 600 MHz broadcast television spectrum incentive auction.[10]

I. INTRODUCTION.

In its initial comments filed over a year ago, NAB identified the issue of co- and adjacent-channel interference likely to result if the Commission adopted a variable 600 MHz band plan.[11] NAB has stated that any methodology used to predict inter-service interference prior to the auction should be based on the twin goals of protecting broadcast viewers from interference and providing wireless carriers, who will be the bidders in the forward auction, with accurate, reliable information that can serve as a sound basis for reasonable investment decisions. Specifically, when identifying licenses, markets or blocks of spectrum that may be impaired, the Commission should provide an accurate picture giving bidders in the forward auction certainty that they actually will be able to deploy and operate wireless broadband services using the spectrum they win at

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[8] The Corporation for Public Broadcasting is a private, non-profit corporation created and authorized by the Public Broadcasting Act of 1967 to facilitate and promote a national system of public telecommunications. Pursuant to its authority, CPB has provided millions of dollars in grant monies for support and development of public broadcasting stations and programming.

[9] The Public Broadcasting Service, with its over 350 member stations, offers all Americans the opportunity to explore new ideas and new worlds through television and online content. Each month, PBS reaches nearly 109 million people through television and over 28 million people online, inviting them to experience the worlds of science, history, nature, and public affairs; to hear diverse viewpoints; and to take front row seats to world-class drama and performances.

[10] *Office of Engineering and Technology Seeks to Supplement the Incentive Auction Proceeding Record Regarding Potential Interference Between Broadcast Television and Wireless Services*, Public Notice, ET Docket No. 14-14, GN Docket No. 12-268, DA 14-98 (rel. Jan. 29, 2014) (*Public Notice*).

[11] NAB Comments, 5-6, GN Docket No. 12-268 (Jan. 25, 2013).

auction. A methodology that paints an overly optimistic picture, however, leading bidders to pursue spectrum they subsequently cannot use to the full extent expected, does those bidders no favors and risks creating an untenable post-auction interference environment. One need look no further than the 700 MHz A block issues to understand just how damaging these oversights can be.

Unfortunately, the methodology OET proposes to use for predicting potential interference between broadcast television and licensed wireless services relies on plainly inaccurate inputs and assumptions, which will lead to the inaccurate calculation of required separation distances. Among other things, OET's proposal:

- assumes operating parameters for wireless base stations that are significantly reduced from the Commission's proposed service rules, and inconsistent with available facts concerning actual deployments;
- ignores combined interference contributions from multiple wireless base stations;
- makes questionable assumptions concerning the interference potential for LTE emissions without testing to confirm such assertions;
- makes unprecedented use of inappropriate field strength prediction characteristics that understate the potential for inter-service interference; and
- selectively uses clutter loss in predicting interference to television service from wireless transmissions.

The proposed methodology is also unnecessarily complex, and will improve neither accuracy nor efficiency. Further, the *Public Notice* fails to provide useful information as to whether or how this methodology will ultimately be used following the

auction. Use of the proposed new OET methodology as a basis for interference protection following the auction, would contravene provisions of the Spectrum Act, which require the Commission to preserve the coverage area and population served of broadcast stations in accordance with OET-69. Such an approach would not be legally sustainable.

II. USE OF THE PROPOSED METHODOLOGY IN REPACKING WOULD VIOLATE THE SPECTRUM ACT.

The *Public Notice* invites comment on "how to use the information derived from the OET Methodology in the context of the repacking of broadcasters."[12] Simply put, the Commission cannot use the proposed new OET methodology as a basis for repacking without violating the Spectrum Act.

Section 6403(b)(2) of the Spectrum Act dictates the means by which the Commission may carry out the incentive auction:

> In making any reassignments or reallocations …, the Commission shall make all reasonable efforts to preserve, as of the date of the enactment of this Act, the coverage area and population served of each broadcast television licensee, as determined using the methodology described in OET Bulletin 69 of the Office of Engineering and Technology of the Commission.[13]

As NAB has explained elsewhere,[14] "methodology" is a term of art that encompasses not just the contents of OET Bulletin 69 ("OET-69"), but also the features of its implementing software needed to generate predictive calculations of coverage area and population

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[12] *Public Notice* at 7.

[13] Spectrum Act, § 6403(b)(2).

[14] Comments of NAB et al. at 3-7, ET Docket No. 13-26 (Mar. 21, 2013); Reply of NAB et al. at 2-5, ET Docket No. 13-26 (Apr. 5, 2013).

served for each broadcast station.[15] Section 6403(b)(2) provides the standard against which the adequacy of the incentive auction and repacking process must be measured: namely, coverage area and population served of each broadcast station using OET-69 and its implementing software as it existed on February 22, 2012. In conducting the incentive auction, the Commission "shall make all reasonable efforts" to preserve those values, meaning that the Commission must "do everything feasible" to preserve the results calculated using OET-69 and its software as of the date of the Spectrum Act.[16]

The *Public Notice* proposes a new and novel methodology for predicting interference between television stations and wireless services. Although OET-69 was not used as of February 22, 2012 to predict interference between broadcast television and wireless services,[17] it *was* (and still is) used to predict coverage area and population served for television broadcasters. And, because interference levels—regardless of their source—directly affect calculations of the populations served by specific television stations,[18] OET-69 (and its implementing software) continues to be the relevant standard for predicting interference. OET's belief that it may have developed a more spectrally

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[15] Statutory terms "must be given their ordinary, contemporary, common meaning." *FTC v. Tarriff*, 584 F.3d 1088, 1090 (D.C. Cir. 2009) (internal quotation marks and citations omitted). "Methodology" means "the processes, techniques, or approaches employed in the solution of a problem or in doing something: a particular procedure or set of procedures." Webster's Third New International Dictionary of the English Language Unabridged 1423 (1976). On the date of the Spectrum Act's enactment, the procedures for calculating coverage area and population served—that is, the "methodology"— included both the contents of OET Bulletin 69 and the software used to convert those contents into usable predictions. *See* OET Bulletin No. 69, at 1 ("A computer is needed to make these predictions because of the large number of reception points that must be individually examined").

[16] *See Raicovich v. U.S. Postal Serv.*, 675 F.2d 417, 423-24 (D.C. Cir. 1982).

[17] *See Public Notice* at 6.

[18] *See, e.g.*, 47 C.F.R. § 73.616(e) (addressing DTV station applications and noting that "population served . . . does not include portions of the population within the noise-limited service contour of that station that are predicted to receive interference from the [other stations]"); *id.* § 73.623(c)(2) ("interference to populations served is to be predicted based on the procedure set forth in OET Bulletin No. 69").

efficient approach cannot trump Congress's clear direction on how to determine coverage areas and populations served for the purposes of the incentive auction. The *only* relevant inquiry under the Spectrum Act is whether the proposed methodology preserves coverage area and population served for each broadcast television licensee as of February 22, 2012, using OET-69 and its then-extant software.[19]

Accordingly, if the Commission intends to introduce any methodology that will change the ultimate coverage area and population served values (as use of OET's proposed methodology as a basis for repacking would do), it must not only identify any such deviations, but also provide a reasoned explanation as to how those deviations do not run afoul of its duty to use "all reasonable efforts" to retain the coverage areas and populations served as of the Spectrum Act's enactment using the OET-69 methodology.[20] The Commission must also provide reasoned explanation for the rejection of alternatives that would have avoided such deviations.[21] "The failure of an agency to consider obvious alternatives has led uniformly to reversal."[22]

OET has not satisfied this obligation. Indeed, the *Public Notice* does not even acknowledge the Commission's duty under the plain language of the statute to preserve

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[19] *See, e.g.*, *Calvert Cliffs' Coordinating Comm., Inc. v. U.S. Atomic Energy Comm'n*, 449 F.2d 1109, 1115 (D.C. Cir. 1971) (agency's statutory responsibilities "must be complied with to the fullest extent," and "[c]onsiderations of administrative difficulty, delay or economic cost will not suffice to strip the [statute] of its fundamental importance").

[20] Spectrum Act, § 6403(b)(2).

[21] *See*, *e.g.*, *Int'l Ladies' Garment Workers' Union v. Donovan*, 722 F.2d 795, 815 (D.C. Cir. 1983) (agency's "failure to consider … alternatives, and to explain why such alternatives were not chosen, was arbitrary and capricious, in violation of section 10(e) of the APA") (footnote omitted); *see also id.* at 815 n.35 ("an agency's failure to 'cogently explain why it has exercised its discretion in a given manner,' renders its decision arbitrary and capricious") (citation omitted).

[22] *Yakima Valley Cablevision, Inc. v. FCC*, 794 F.2d 737, 746 n.36 (D.C. Cir. 1986). *See also Achernar Broadcasting Co. v. FCC*, 62 F.3d 1441, 1447 (D.C. Cir. 1995) (FCC reversed for failing to consider "all aspects of the problem" and failing to examine "a viable option" presented by a party).

the coverage areas and populations served, as of the date of the Spectrum Act. Instead, the *Public Notice* seeks comment on a variety of questions rendered irrelevant by the Spectrum Act, such as whether the proposed methodology "can provide greater accuracy than a generic separation distance," and whether it would "strike a more appropriate balance between efficiency of spectrum use and the technical analysis required in the incentive auction."[23] Laudable as these goals might appear in the abstract, they are not the criteria that Congress specified.[24] Again, Congress's choice to preserve broadcasters' coverage areas and populations served was not a mere suggestion, but a statutory direction.

The Commission must explain: (1) how the proposed OET methodology alters the OET-69 methodology as of the date of the Spectrum Act's enactment; (2) how those changes affect coverage area and population served; and (3) how any changes in coverage area and population served are consistent with the Commission's duty to use "all reasonable efforts" to avoid significant deviations, including why reasonable alternatives that would have resulted in fewer changes were not adopted. Until the Commission does so—and in a format that provides sufficient notice and opportunity for meaningful public comment—it has not fulfilled its statutory obligations and therefore

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[23] *Public Notice* at 4.

[24] *See Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) ("Normally, an agency rule would be arbitrary and capricious if the agency has relied on factors which Congress has not intended it to consider . . . ."); *Owner-Operator Indep. Drivers Ass'n, Inc. v. Fed. Motor Carrier Safety Admin.*, 494 F.3d 188, 207 (D.C. Cir. 2007) ("An agency acts arbitrarily if it ignores an issue that Congress directs it to address").

cannot use the proposed OET methodology in the context of repacking without running afoul of Congress's express intent.[25]

III. THE PUBLIC NOTICE PROVIDES INSUFFICIENT INFORMATION ON THE EXPECTED USE OF THE PROPOSED METHODOLOGY AND FAILS TO CLEARLY IDENTIFY INTERFERENCE PROTECTION RULES AND RIGHTS OF TELEVISION AND WIRELESS SERVICES SHARING THE SAME SPECTRUM.

The *Public Notice* introduces a new "methodology for predicting potential interference between television and wireless services," and seeks comment on whether this methodology "can provide greater accuracy" and will allow the Commission to "repurpose more spectrum."[26] However, the *Public Notice* provides only a vague sketch of the proposed methodology, without identifying or explaining specific changes it entails and how they will affect calculations of television stations' coverage areas and populations served. OET also does not explain how this new methodology differs from the *TVStudy* methodology that OET is developing to predict broadcaster interference. As NAB has explained previously, OET must provide more specific information and transparency—including information about OET's own studies of the proposed methodology—to allow the public an opportunity to provide meaningful comment.[27]

Because the *Public Notice* identifies only some of the changes made to the methodology described in OET-69, the Joint Broadcasters are limited in their ability to offer meaningful comments on the proposed methodology. Indeed, OET's persistent

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[25] *See Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) ("'We may not supply a reasoned basis for the agency's action that the agency itself has not given'") (quoting *SEC v. Chenery Corp.*, 332 U.S. 194, 196 (1947)).

[26] *Public Notice* at 4.

[27] *See, e.g.*, *Am. Radio Relay League*, 524 F.3d at 236 ("'[i]n order to allow for useful criticism, it is especially important for the agency to identify and make available *technical studies and data* that it has employed'") (quoting *Conn. Light & Power Co. v. Nuclear Regulatory Comm'n*, 673 F.2d 525, 530 (D.C. Cir. 1982)); *see also* Comments of NAB et al. at 17-23, ET Docket No. 13-26 (Mar. 21, 2013); Reply of NAB et al. at 15-16, ET Docket No. 13-26 (Apr. 5, 2013).

practice of altering the OET-69 software without providing the public adequate notice of the changes being proposed—including the reasons for the changes and their effects—denies the public the ability to comment meaningfully on whether those changes comply with the Commission's statutory duty to use "all reasonable efforts to preserve, as of the date of the enactment of [the Spectrum Act], the coverage area and population served of each broadcast television licensee, as determined using the methodology described in OET Bulletin 69."[28]

As NAB has explained in the related *TVStudy* Proceeding, changes of this magnitude cannot be made informally by the staff; if these changes can be made at all, they must follow a formal notice of proposed rulemaking by the full Commission.[29] The Spectrum Act specifies the methodology that must be used in the incentive auction to determine coverage area and population served for each broadcaster, and the Commission has not articulated an interpretation of Section 6403(b)(2) of the Spectrum Act that would permit the use of a different methodology. OET's delegated authority does not extend to considering "new or novel arguments not previously considered by the Commission," or adopting positions that represent "a change in Commission policy."[30] Before adopting novel methodology for calculating co- or adjacent-channel interference, the Commission must publish a formal notice of proposed rulemaking that explains how it has made all reasonable efforts to preserve coverage area and population served for

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[28] Spectrum Act, § 6403(b)(2).

[29] *See* Comments of NAB et al. at 17-19, ET Docket No. 13-26 (Mar. 21, 2013).

[30] 47 C.F.R. § 0.241; *see also id.* § 0.5(c) (authority delegated to OET only for "matters which are minor or routine or settled in nature and those in which immediate action may be necessary").

each broadcast television licensee,[31] and allow the public sufficient time to evaluate the proposed methodology and provide meaningful comment.[32]

The Joint Broadcasters urge OET to engage in open and transparent dialog with stakeholders and to provide more specific information, including information about its own studies of the methodology proposed in the *Public Notice*. We ask OET to reject the procedurally infirm practice currently being used in the *TVStudy* Proceeding, in which changes that are not logical outgrowths of the initial public notice are made and published to a private email distribution list rather than the public at-large.[33]

Beyond these serious procedural infirmities, the *Public Notice* moreover fails to articulate clearly the substantive purpose and expected use of the proposed methodology. For example, is the purpose of the methodology to inform wireless bidders in the forward auction as to the geographic areas that could potentially be impaired, or to determine interference protection rights of television stations and wireless carriers sharing the same spectrum, or both?

It makes little sense to proceed with the proposed methodology in a vacuum. The methodology for identifying potentially impaired wireless markets is but one piece of a complex, interrelated interference environment that will exist following the incentive auction and repacking. Moving forward without solving the other pieces of the puzzle will

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[31] Spectrum Act, § 6403(b)(2).

[32] *See* 5 U.S.C. § 553(b), (c); *Am. Radio Relay League*, 524 F.3d at 236 ("Enforcing the APA's notice and comment requirements ensures that an agency does not 'fail[] to reveal portions of the technical basis for a proposed rule in time to allow for meaningful commentary'") (citation omitted); *Gerber v. Norton*, 294 F.3d 173, 179 (D.C. Cir. 2002) (the "opportunity for comment must be a meaningful opportunity").

[33] *See Envtl. Integrity Project v. EPA*, 425 F.3d 992, 996 (D.C. Cir. 2005) (final action must be a "logical outgrowth" of prior notice, and agencies may not "pull a surprise switcheroo on regulated entities").

not provide forward auction bidders with certainty regarding what exactly they are bidding on, and fails to assure broadcasters that the Commission will comply with the clear mandate of the Spectrum Act to preserve service. Without a clear understanding of the interference protection standards to be applied to broadcasters that do not participate in the auction and that will remain in the band either on their existing channels or repacked on a new channel, it is impossible to provide complete comments with regard to this PN and the proposed methodology.

The Commission has had more than a year to develop clear proposals to address the serious potential co- and adjacent-channel interference inherent in a variable band plan. Prior to this *Public Notice*, the Commission had never taken notice of the co- and adjacent-channel interference issue. It is not mentioned in any document to date voted on by the Commission. At this point, the Commission should either abandon its proposed variable band plan, or comply with the APA and release a rulemaking notice with specific proposals for the protection of broadcasters and the coexistence of wireless service and broadcast television service in the same band. Such a notice should propose rules ensuring that the Commission will not auction spectrum in areas that will cause interference to DTV operations and that forward auction bidders will be fully informed with respect to applicable restrictions on spectrum on which they are expected to bid. Most importantly, the Commission should propose clear rules for wireless service in the 600 MHz band that will fully protect broadcast operations. Until specific rules are in place requiring wireless licensees to protect fully the coverage area and population served by DTV stations as required by the Spectrum Act, the Commission cannot proceed with the incentive auction.

IV. THE PROPOSED OET METHODOLOGY RELIES ON CLEARLY ERRONEOUS ASSUMPTIONS AND INPUTS THAT SIGNIFICANTLY UNDERESTIMATE INTER-SERVICE INTERFERENCE.

The Joint Broadcasters agree with OET's characterization of the four potential interference scenarios between broadcast television and wireless services.[34] The *Public Notice* also provides useful information characterizing the wireless base station receiver and the wireless user equipment receiver, and highlighting the difference in channel bandwidth between DTV and wireless and the need to take the spectral overlap into account. However, many of the assumptions used in the proposed OET methodology appear seriously flawed and lack a sound technical justification.

These errors *all* underestimate the extent of potential interference between broadcast DTV operations and wireless services, and their effects are cumulative. As a result, the OET methodology will likely significantly understate the number of areas within wireless markets that will be impaired as well as the degree of impairment. While this might give the appearance of spectral efficiency and allow the Commission to claim that fewer wireless markets were impaired, the model cannot change the reality of post-auction operations and interference.

A. The OET Methodology Relies on Unfounded Assumptions Regarding the Antenna Height and Transmitter Power of Wireless Base Stations.

The receive antenna height of the wireless base station affects the amount of interference that will be received from broadcast operations. All else equal, a higher antenna will receive more interference from a broadcast signal. Similarly, the transmitter antenna height and transmitter power of the wireless base station affects the amount of

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[34] The four cases are: Case 1) DTV transmitter-into-wireless base station (uplink) interference; Case 2) DTV transmitter-into-wireless user equipment (downlink) interference; Case 3) Wireless base station (downlink)-into-DTV receiver interference; and, Case 4) Wireless user equipment (uplink)-into-DTV receiver interference.

interference that will be caused by wireless transmissions. The proposed methodology relies on inaccurate values for wireless base station antenna height and transmitter power – which means that it underestimates both the amount of interference that wireless base stations will *receive* and the amount of interference they will *cause*.

Specifically, the OET methodology assumes that a wireless base station receiver has a receive antenna height of 30 meters, or about 100 feet, and operates with an ERP of 720W or 120W/MHz.[35] Both of these values are significantly less than what would be permitted under the Commission's proposed rules for wireless operations in the 600 MHz band, which would permit wireless base station facilities to operate at up to 305 meters with 1000W/MHz of transmit power.[36] Use of the proposed OET methodology could well predict that wireless operation in a particular area would not be subject to impairment (either because it would receive or cause harmful interference), but deployment of wireless broadband service in accordance with the applicable proposed service rules would, in fact, be impaired.

Beyond the fact that the assumed facilities parameters are inconsistent with the rules, they appear to be inconsistent with real-world wireless facilities. For example, American Tower's National Site List shows 704 wireless facilities in Alabama. Only 19 of these facilities are listed at 100 feet or less, and more than 500 reach heights exceeding 200 feet above ground.[37] In fact, the average wireless tower height in Alabama is 247.4

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[35] *See Public Notice* at 22.

[36] *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Notice of Proposed Rulemaking, 27 FCC Rcd 12357 (2012).

[37] *See* American Tower's National Site List, available at https://www.americantower.com. Counts of wireless facilities included all standalone wireless facilities, including monopoles, self-supporting and guyed towers. The counts excluded rooftop, on building and broadcast towers and those few instances where the height above ground of the facility was listed as unknown.

feet. Similarly, in Maryland, of 336 wireless facilities only 15 are listed at 100 feet or less, and 83 towers, or almost a quarter of the facilities, are listed at more than 200 feet. The average wireless tower height in Maryland is 192.5 feet. In the state of New Jersey, there are 201 wireless facilities listed, with only eight sites at the 100 feet or less. The average height of wireless facilities in the state of New Jersey is 168 feet.[38] In Pennsylvania, there are 826 wireless facilities with an average height of 187.5 feet, but only 59 at a height of 100 feet or less.

Thus, the OET methodology makes assumptions inconsistent with both Commission's proposed rules and readily ascertained information about actual wireless service deployment. In both cases, *OET's erroneous assumptions are slanted towards predicting less interference than would likely actually be observed*.

To remedy these errors, the Joint Broadcasters suggest that the Commission either align the service rules for wireless operation in the 600 MHz band with the parameters assumed in the OET methodology, or adjust the parameters used in the methodology to be consistent with the proposed rules. In addition, the Commission should unequivocally establish that wireless operations, even in areas predicted to be "unimpaired" by the OET methodology, must not cause interference to DTV operations. Otherwise, the OET methodology will inevitably fail to achieve its ostensible purpose – to predict and prevent potential inter-service interference with a reasonable degree of accuracy and reliability. Clearly, if the major purpose of this exercise, as set forth in the *Public Notice*, is to determine whether a wireless licensed service is "unimpaired,"

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[38] New Jersey has a large number of wireless sites on buildings and rooftops. For example, wireless facilities are on the International Financial Tower, 95 Christopher Columbus Drive, Jersey City, New Jersey, a 16 story, 303 feet tall building. Rooftop facilities were not included in our counts.

operation in accordance with the rules should not be prohibited within an unimpaired licensed wireless coverage area.

B. The OET Methodology Ignores the Cumulative Effect of Multiple Wireless Transmitters

To predict potential interference from wireless service to broadcast DTV, the OET methodology assumes a deployment of hypothetical wireless base stations uniformly spaced every ten kilometers, with transmitting antennas at 30 meters above ground, in every wireless license area within 500 km of the DTV facility. Undesired field strength from each hypothetical base station is then predicted at each grid point within the DTV coverage area, and the desired to undesired signal ("D/U") ratio is determined by comparing the predicted or desired DTV signal and the interfering or undesired signal from a *single* individual hypothetical base station to determine whether that hypothetical base station is predicted to cause interference.

In reality, wireless providers are likely to have a large number of cell sites in close proximity operating over a wide area with high traffic volumes at multiple base stations at the same time. Transmissions from multiple base stations can combine and cause interference to DTV service, even in cases where a single wireless signal may not cause interference.

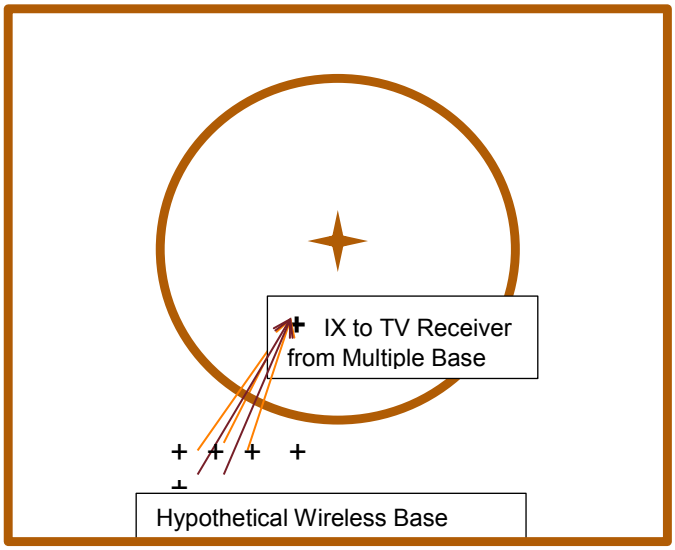

Figure 1.

This signal combining interference phenomena is well understood. In fact, the recently established rules governing Digital Television Distributed Transmission Systems ("DTS") address this issue.[39] DTS employ multiple synchronized transmitters spread around a DTV station's service area similar to a wireless cellular network architecture. To ensure that DTS transmissions do not interfere with DTV reception, the rules provide that the *combined* effect of all DTS transmitters must be taken into account in interference calculations. Specifically, the Commission requires that the root-sum-square (RSS) method of calculating interference from multiple DTS transmitters must be used to calculate both adjacent channel and co-channel interference.[40]

This situation is similar to what would occur in a wireless environment, and OET cannot simply ignore interference from multiple wireless transmitters. According to the

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[39] *See In the matter of Digital Television Distributed Transmission System Technologies,* Report and Order, 23 FCC Rcd 16371 (2008) ("*DTS Report and Order*").

[40] *See id.* at ¶¶ 47-48; *see also* 47 C.F.R. §73.626(f)(5).

proposed OET methodology, a DTV receiver receiving a 65 dBμ DTV signal and two 50 dBμ interfering signals from two proximate co-channel wireless sites would be deemed to have no interference since each wireless base station would meet the 15 dB D/U ratio (for each transmitter, D/U = 65 dBμ - 50 dBμ = +15 dB). However, these interfering signals will have an additive effect and create interference when combined. Using the RSS method, the two 50 dBμ signals would yield an interfering signal of 70 dBμ and result in a D/U ratio at the RTV receiver of -5 dB rather than +15 dB (D/U = 65 dBμ - 70 dBμ = -5dB).

As the Commission already found with multiple DTS transmitters, the combined interference effect of multiple transmitters needs to be taken into account and "the RSS method in virtually all situations will best approximate actual interference" from multiple transmitters to DTV signals.[41] Failure to consider the combined interference effect of multiple wireless base stations will result in increased interference to DTV stations. The Commission has a statutory responsibility to protect broadcasting and DTV viewers and cannot ignore "real world" interference from multiple wireless operations; thus, any methodology used to predict potential inter-service interference should take this into account. The Joint Broadcasters urge the Commission to consider interference from multiple wireless base stations using either a simple direct summation method or the RSS method utilized for calculating interference from multiple DTS transmitters under the current rules.

We are also troubled by the assumption that wireless facilities will be uniformly spaced every ten kilometers. Precisely how and where wireless base stations are placed

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[41] *See DTS Report and Order* at ¶ 47.

within the ten kilometer uniform spacing will change the results and these changes can be especially significant in an irregular terrain environment.[42] Further, as the *Public Notice* acknowledges, wireless facilities in practice can be located every few fractions of a kilometer in dense urban markets.[43] The assumption that cells will be spaced every ten kilometers severely underestimates the likely number of wireless facilities and the interference potential from these wireless operations to DTV viewers.[44] According to the *Public Notice*, the ten kilometer wireless transmitter spacing was based primarily on computational limitations, not based on modeling practical interference issues associated with real world wireless deployments.[45] While the Joint Broadcasters are sensitive to computational limitations associated with using the complex OET methodology, the appropriate solution to that problem is to use a simpler methodology – not to make demonstrably false assumptions that will underestimate the potential for inter-service interference.

C. The Assumption that LTE OFDM-Based Services Have the Same Interference Potential as ATSC Digital Television Is Questionable.

The proposed methodology asserts that 600 MHz wireless services are expected to be "noise-like" and that studies have shown that noise-like signals have interference potential nearly identical to that of ATSC digital television signals.[46] To support this claim,

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[42] The terrain over ten kilometers can change significantly and differences can occur, for example, if the uniform ten kilometer spacing places base stations on top of hills or in valleys. The OET Methodology provides no guidance on how the ten kilometer uniform spacing will be determined.

[43] *Public Notice* at 14, n. 12.

[44] The 10 km spacing may be appropriate as a co-channel wireless reuse distance but not as a typical cellular deployment where one would expect adjacent channel wireless operations between these co-channel cells.

[45] *Public Notice* at 14, n. 12 ("The uniform 10-kilometer spacing for base station transmitting sites we describe in this appendix approaches a practical limit on computation.")

[46] *Public Notice* at 5.

the *Public Notice* cites to two OET studies of DTV receivers in 2005 and 2007.[47] However, neither of studies provides significant information on the interference potential of wireless LTE emissions to DTV signals.[48]

Testing underlying the 2005 report simply used a laboratory white noise generator that was flat across the bandwidth of the selected TV channel to determine threshold of visibility ("TOV") and carrier-to-noise ratios ("CNR"). LTE emissions, however, are not the same as "white noise" signals; they are Orthogonally Frequency Division Multiplexed ("OFDM") modulated signals. The 2007 report testing did include some limited tests with both a Gaussian noise signal and a DVB-H (5MHz OFDM) signal. However, these tests were conducted on the upper and lower *second* adjacent channel, and the lower third, fourth and sixth adjacent-channels – not on co- or immediately adjacent-channels.[49] The report also concluded that even on these relatively far removed channels, "the results show that the DTV receivers are more vulnerable to out-of-channel interference from OFDM signals than from the 8-VSB DTV signal by an amount just over 1dB."[50]

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[47] *See* Stephen R. Martin, "Tests of ATSC 8-VSB Reception Performance of Consumer Digital Television Receivers Available in 2005 ("2005 Report"), FCC/OET Report TR-05-1017 (Nov. 2, 2005); and, "Interference Rejection Thresholds of Consumer Digital Television Receivers Available in 2005 and 2006 ("2007 Report"), FCC/OET Report 07-TR-1003 (March 30, 2007).

[48] Virtually all co-channel interference testing that has been performed for ATSC television signals has been performed with either analog NTSC or digital ATSC interferers that precisely align in the same 6 MHz channel allocations. The ATSC system's VSB modulation was specifically designed with an NTSC interference rejection filter with nulls at the NTSC picture and color subcarrier frequencies in order to tolerate high levels of analog signal interference, which was essential to enable practical DTV signal coverage during the simulcast transition period. With respect to ATSC into ATSC co-channel interference, we agree with the Commission that a large body of testing evidence indicates that the interference is similar to the effects of "noise," specifically AWGN. However, there is no substantial body of testing on the co-channel interference characteristics of LTE OFDM-based signals into ATSC receivers.

[49] *See* 2007 Report at Tables 7-4 and 7-5 on pp. 7-6 to 7-7.

[50] 2007 Report, at summary p. x. Although 1 dB of difference may not seem substantial, ATSC A/74 Guidelines for Receiver Performance, Tables 5.2 and 5.3, demonstrate that for moderate and weak desired signal levels and an ATSC interferer, there is a 7 dB and 11 dB difference in

Given the lack of evidence and testing, it is highly speculative to assume that interference from LTE will be similar to DTV signals. In addition, there is no evidence to support the assumption that interference and D/U limits can be modeled as a simple function of spectral overlap power, as suggested in the proposed methodology. In fact, neither the 2005 nor the 2007 report provides any data or testing to support such an approach, and there are good reasons to suspect that this approach is inaccurate.

Digital signals are generally characterized by their peak-to-average power ratio. At any given moment in time, the peak power of a digital signal may be significantly higher that its average power. ATSC signals were designed to have a very low peak-to-average power ratio, on the order of 6 dB. In contrast, today's wireless broadband systems use an LTE-OFDMA (Orthogonal Frequency Division Multiple Access) based technology in the downlink that permits a number of possible transmission modes such as QPSK, 16-QAM and 64-QAM, where the peak power is the sum of the peak power on each of its multitude of carriers and the peak-to-average ratio can be up to 12 dB.[51]

Digital modulation systems generally encode signals into a short sequence of transmitted symbols and rely on the ability of a receiver to correctly receive and decode the sequence of transmitted symbols. For example, the ATSC 8-VSB system symbol rate is 10.76 Msymbols/sec, meaning that one of eight possible symbols, conveying three bits

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the level of second adjacent channel that can be tolerated compared to first adjacent. http://www.atsc.org/cms/standards/a_74-2010.pdf Thus, it is reasonable to expect that an adjacent channel OFDM interferer will exhibit more "un-noise" like behavior than the 1 dB second adjacent channel test that was referenced might suggest.

[51] LTE uses SC-FDMA (Single Carrier-Frequency Division Multiple Access) for the uplink. Even the smaller peak-to-average characteristic of SC-FDMA is that peaks can be 8 dB for QPSK and 10 dB for 16 QAM.

of information, is transmitted every 920 nanoseconds. Co-channel signal interference is not a long-term-average effect; rather it is a cumulative effect of the instantaneous interference present during each transmitted symbol.

Given the difference in the peak-to-average ratio between the two digital systems, it is reasonable to surmise that the occurrences of high instantaneous power of an OFDM co-channel interferer could behave like impulse noise and cause significant disruption to ATSC receivers. Indeed, vulnerability to impulse noise is one of the weaknesses of digital modulation in general. This problem is not unique to ATSC and its VSB modulation; it has also been widely recognized as a problem in DVB-T and its OFDM modulation. Thus, the assumptions that co-channel interference from LTE wireless broadband transmissions into ATSC television transmissions is "noise like" may not be correct. If the Commission chooses not to adopt a single, nationwide band plan, the Joint Broadcasters urge the Commission to determine the interference characteristics of LTE signals and their higher peak-to-average levels into ATSC signals by thorough laboratory testing, rather than mere speculation.

The Joint Broadcasters are also concerned about the methodology used to compute the interference limits for different amounts of spectral overlap of LTE co-channel interference into ATSC transmissions. The proposed methodology assumes that all frequency (or time) portions of an ATSC signal are equally robust to interference, or that interference in a portion of the 6 MHz channel can be calculated on a pro-rata basis of the spectral width of an interfering signal. Such an assumption may not be valid.

As noted above, the ATSC 8-VSB signal has a symbol rate of 10.76 Msymbols/sec. The symbol waveform's pulse-shaping filters are designed to have a "square root of raised cosine" characteristic in order to shape the signal spectrum to the

desired 6 MHz channel occupancy. Like any single-carrier modulation system, ATSC's 8-VSB conveys its data in each symbol, but the information needed to synchronize symbol recovery at a receiver is conveyed in the extreme edges of the 6 MHz band, in what is called the "excess bandwidth" of the signal. 8-VSB also uniquely employs a "pilot tone" in the lower band edge. Designed to be highly spectrally efficient, 8-VSB uses a very small excess bandwidth that is more susceptible to interfering signals. Moreover, based on the earlier measurements at the FCC, interference rejection thresholds of the VSB receiver can vary substantially.[52] Some receivers make use of the pilot tone in the lower band edge, other receivers make more extensive use of the upper band edge or both band edges.

Adjacent-channel interference is another area where the impact of various interfering signals should not be assumed to be the same. Although thorough adjacent-channel interference testing of ATSC signals has been performed with either ATSC or NTSC adjacent channel signals as the interfering signals, such testing has not been performed with OFDM signals as the interferers. An ATSC upper or lower adjacent channel interferer has its power distribution shaped in frequency by both the pulse shaping filters of the VSB signal and ultimately by the RF filter of the DTV transmitter, in order to comply with the FCC emission mask. At the time of its design, the ATSC VSB signal significantly advanced the state of the art in reducing excess bandwidth and achieving high spectrum efficiency. This results in the FCC adjacent channel D/U ratio planning factors of -26dB and -28 dB as set forth in the Sixth Report and Order and the ATSC Receiver Performance Guidelines set forth in ATSC A/72. However, OFDM

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[52] *See* 2005 and 2007 Reports.

systems such as LTE have even higher energy distribution near their band edges, potentially resulting in worse adjacent channel interference into an ATSC signal than might be caused by an adjacent ATSC signal. Additionally, the emission mask for uplink and downlink LTE transmissions in the 600 MHz band must be determined by the Commission and it could have a significant impact on the adjacent channel signal levels that can be tolerated by legacy DTV receivers.

It is also important to understand that adjacent channel interference in television receivers occurs not just because of spectral “leakage” but also because of nonlinearities in an RF front end and tuner. Unlike LTE devices that are designed to work at a few pre-specified frequencies, television tuners are designed to operate across a wide range of frequencies (from VHF to UHF) and across a wide range of received signal levels. Cost-effective tuner designs for consumer television receivers exhibit nonlinearities that can cause intermodulation products from high power adjacent channel signals. Both the higher band-edge energy, the to-be-determined LTE emission mask and the higher peak-to-average power ratios of LTE signals have the potential to cause greater adjacent channel interference to legacy DTV receivers than an adjacent-channel ATSC signal, and upper- and lower-adjacent performance can be significantly different. Only thorough laboratory testing using a suitable variety of receiver implementations can determine the appropriate adjacent channel interference levels that will be acceptable for ATSC receivers.

It is thus inappropriate to assume that ATSC signals are equally robust to interference for different amount of spectrum overlap, and that the interference can be determined using a pro-rata basis of the spectral width. The Commission should determine the interference characteristics of spectrally-overlapped LTE signals into ATSC

signals by thorough laboratory testing across the set of possible spectral overlap conditions using a suitable variety of receiver implementations.

D. The Proposed Methodology Is Inconsistent with OET-69 Service Predictions

The methodology described in OET Bulletin 69 calculates the field strength values used to predict the coverage of a DTV station and the interference from all other interfering DTV stations. In a few instances, if the model determines that a field strength value in a particular location within the DTV station's predicted service contour is unreliable, it returns an "error code 3" message. Using OET-69, areas where error code 3 occurs inside the noise limited contour of a DTV station are deemed to have service, and the error 3 "predicted field strength" values are ignored.

The proposed methodology proposes a change in the treatment of error code 3 for calculating a DTV station's coverage and population.[53] Under the proposed methodology, the error code 3 message would now be accepted as the field strength value available at the location – in essence changing the manner in which the coverage and population served of a DTV station is calculated when considering interference from a wireless operation. The use of two different and conflicting methodologies to determine the coverage and population of a DTV station, one to determine the area that must be preserved in accordance with the Spectrum Act, and another to predict which markets should be considered impaired in the forward auction, is not only bad science, it also directly conflicts with the requirements of the Spectrum Act.

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[53] *See Public Notice* at 18

E. The Proposed Methodology Incorrectly Applies Clutter Factors

The *Public Notice's* methodology inaccurately and artificially reduces the predicted impact of interference from wireless service to DTV broadcast service by incorrectly applying clutter factors.[54] The proposed methodology adds a 5 to 8 dB clutter loss to the interfering wireless signal, effectively reducing the interfering wireless signal by up to 250 percent. This methodology does not, however, apply a similar clutter loss to the received DTV signal. That is, the proposed methodology assumes that viewers' DTV antennas are completely free of any obstruction to desired DTV signals, while simultaneously assuming that undesired interfering signals potentially received by those same DTV antennas are reduced by up to 250 percent by clutter.

There is no technical rationale for this selective use of clutter loss, which severely and artificially understates undesired signal strength while overstating desired signal strength. To suggest, for example, that all of the trees in an area classified as "Forest Land" or all of the buildings in an area characterized as "Residential" would be aligned so as to block the undesired interfering signals from multiple wireless base stations to viewers' DTV antennas, but those same DTV antennas would be completely free of any obstruction to the desired DTV signals is simply irrational. Clutter should not be considered on the interfering wireless signal to DTV viewers' home reception.[55]

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[54] The OET Methodology applies clutter to interference from the base station and wireless user equipment to the DTV receiver. Clutter is also applied to interference from the TV transmitter to the wireless user equipment. This section deals primarily with interference to DTV.

[55] Use of clutter for both wireless and DTV signals would be inconsistent with the Spectrum Act's requirement to use OET-69 as the basis for preserving coverage area and population served. Further, clutter as used in the proposed OET methodology is significantly different that its use in the context of determining over-the-air television reception at a specific individual location. In the case of the OET methodology, the reception point being analyzed represents *all DTV reception* over a four square mile area of coverage, in which clutter values may be significantly different. OET Bulletin No. 73 methodology results apply only to the specific individual location being

At the Commission's February 21, 2014 workshop[56] to explain the proposed methodology, OET staff indicated that the use of clutter was based on its use in OET Bulletin No. 73, and the *Public Notice* cites OET-73 as a reference for clutter factors.[57] OET Bulletin No. 73 is *not* used for interference calculations, but rather to determine whether a specific, individual location is served. [58] The proposed *Public Notice* methodology is intended to model DTV reception and interference within an entire area of four square kilometers. However, the methodology uses only a single clutter value despite the fact that four square kilometer areas can contain a number of different clutter categories and associated clutter loss values. The map below, from the National Land Cover Database, shows an area located in the Research Triangle in North Carolina, and shows different clutter categories. Each different color represents a different land cover classification, and it is readily apparent that clutter can vary significantly even over short distances.[59]

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investigated. The analysis of DTV reception using OET Bulletin 73, including the use of clutter, results in a finding that adequate over-the -air DTV coverage is available at the individual's residence or results in the viewer having the choice of satellite reception. In this case, the likely result is that current viewers and consumers will simply be denied DTV service due to the fact that the proposed OET methodology underestimates interference from wireless operations.

[56] *OET Announces Agenda for Workshop on Inter-Service Interference Prediction*, Public Notice, ET Docket No. 14-14, GN Docket No. 12-268, DA 14-186 (rel. Feb. 11, 2014).

[57] *Public Notice* at 25, n. 26.

[58] *See* OET Bulletin No. 73, *The ILLR Computer Program for Predicting Digital Television Signal Strengths at Individual Locations*, November 23, 2010, at p. 3.

[59] *See* www.mrlc.gov/nlcd2006.php

The *Public Notice* also seeks comment on whether clutter should be considered, and what are appropriate clutter losses, for interference cases involving user equipment.[60] For the reasons cited above, clutter should not be used in determining separation distances necessary between DTV and wireless base stations. The Joint Broadcasters also believe that if these separation distances are correctly computed, the

[60] *Public Notice* at 6.

user equipment issue will be largely resolved; as noted in the *Public Notice*, user equipment transmitters will operate in close proximity to a wireless base station that is always located far enough away from co-channel DTV operations so as to avoid inter-service interference.[61] With regard to user equipment operation, the Commission's TV White Spaces rules provide appropriate guidance and the Commission should establish similar separation distances for wireless user equipment.[62] Specifically, user equipment should be at least five kilometers outside the co-channel protected contour of a DTV station and 0.5 kilometers outside the contour of an adjacent channel DTV station.

F. The Proposed Methodology Uses Inappropriate Field Strength Prediction Statistics to Calculate Interference.

The *Public Notice* seeks comment on the appropriate statistical parameters for the Longley-Rice model when examining DTV field strength at the wireless receiver.[63] The proposed OET methodology uses field strength values based on median situations for 50 percent of the locations, 50 percent of the time (*i.e.*, F(50,50)) for determining DTV interference to wireless receivers. The rationale for taking this approach is to account for "technologies and techniques that wireless licensees might employ to mitigate interference, such as antenna characteristics and resource block provisioning."[64] The use of the median time variability statistics in the prediction of interference between two

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[61] *Public Notice* at 4.

[62] 47 C.F.R. §15.712. The interference protection rules for TV White Spaces (TVWS) specify a distance of 4.0 km for co-channel and 0.4 km for adjacent channel for a 100 mW TVWS device. Table 11 of the Appendix to the *Public Notice*, suggests that LTE operations are anticipated to operate at 120 mW. Therefore, a slight adjustment was made to the TVWS separation distances.

[63] *Public Notice* at 6.

[64] *Public Notice* at 4.

high power transmitters is unprecedented and contrary to sound engineering practice.[65] The more appropriate and universally accepted statistics for predicting interference are based, at a minimum, on median situations for 50 percent of the locations, ten percent of the time (*i.e.*, F (50, 10)). In fact, a sharing arrangement between the FCC and the Department of Industry of Canada for use of the 768-776 MHz and 798-806 MHz bands by land mobile service along the border requires applicants to perform separation distance calculations using location and time variables of ten percent (*i.e.*, F (10, 10)).[66] The arrangement describes this as "good engineering practice."[67]

Using the F(50, 50) prediction statistics means that the predicted interfering field strength of the DTV signal will be higher than predicted at the wireless receiver 50 percent of the time for a given period. While NAB recognizes that wireless carriers may employ interference mitigation techniques, wireless carriers will likely need to use these techniques to mitigate interference and improve service beyond the level predicted using the traditional F(50, 10) prediction statistics. After all, using F(50, 10) prediction statistics still implies that predicted interfering field strength will be higher than predicted ten percent of the time – an interference environment wireless carriers will surely wish to mitigate.

In addition, to the extent that the rationale for use of the F(50,50) prediction statistics is based on wireless carriers employing certain interference mitigation techniques to make up for the difference between F(50, 50) and F(50, 10), this rationale

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[65] See Roger B. Carey, "Technical Factors Affecting the Assignment of Facilities in the Domestic Public Land Mobile Service", FCC/OCE Report No. R-6404, at 5 (June 24, 1964).

[66] *FCC and Industry Canada Agree on New Spectrum Sharing Arrangements Along the U.S.-Canada Border*, News Release, Arrangement Q at 6 (Aug. 20, 2013).

[67] *Id.*

ignores the need for wireless carriers to also mitigate against higher than predicted interference given the use of suspect assumptions in the OET methodology, such as ten kilometer uniform spacing, reduced transmit power and lower antenna heights, and selective clutter.

Miscalculating separation distances and permitting wireless receivers to be located too close to DTV transmitters will also increase the potential for interference to DTV viewers. Any methodology to determine inter-service interference between broadcast and wireless operations should be based on long-standing use of the FCC's F(50, 10) prediction statistics, rather than unfounded assumptions that wireless carriers can mitigate against all of the cumulative effects of the erroneous assumptions and inputs in the OET methodology *as well as* the unprecedented use of F(50,50) prediction statistics.

G. An Approach Based on Separation Distance Is Not Overly Conservative or Spectrally Inefficient.

OET suggests that prescribing pre-defined separation distances, as proposed by commenters addressing the issue of co- or adjacent-channel interference, may be spectrally inefficient and overly conservative, and would effectively lump together all interference cases and apply separation distances based on a worst case scenario.[68] In fact, in its submissions on this issue, NAB did not "lump together" the interference scenarios, nor did it provide a "worst case" analysis. Rather, NAB provided a range of separation values and specifically noted that these distances are affected by the technical characteristics of the stations involved, such as transmitting height and power of DTV stations and wireless base stations.

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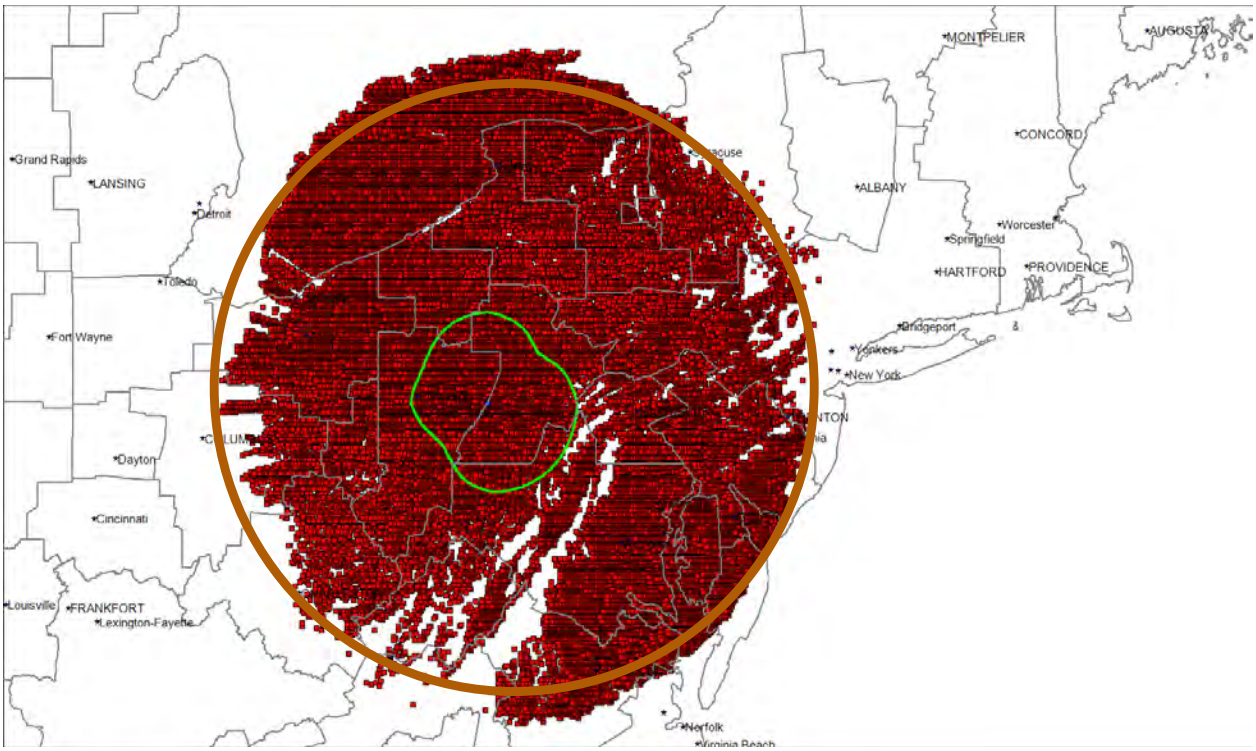
[68] *Public Notice* at 4.

NAB presented these distance calculations to demonstrate that a serious co- and adjacent-channel inter-service interference problem existed and that the Commission needed to take this issue into account in the auction process and beyond if it was considering a variable band plan. While OET should be commended for addressing this issue, its proposed methodology is unnecessarily complex in the context of an already challenging auction. Attempting myriad computations on "hypothetical" wireless deployments does not yield more accurate results nor provide more spectrum efficiency. A simpler approach, where separation distances are representative of potential interference between DTV and wireless service, is far easier to implement and will not sacrifice meaningful spectral efficiency.

The following plot was shown at the Commission's February 21 LEARN Workshop regarding the proposed OET methodology. The plot represents the potential for interference from a DTV station to a wireless base station. The station used in this plot is a DTV station in Johnstown, Pennsylvania. Presumably, this DTV station was selected because the irregular terrain in this part of the country would emphasize the difference between using the proposed OET methodology and a simple separation distance or contour. However, *even in this highly irregular terrain*, the practical difference between methods is minimal with respect to spectral efficiency. The contour was added to the LEARN Workshop slide to show what a typical separation distance or contour approach would look like.



To the extent that certain “white spaces” are present within the contour, these generally represent mountain ranges with little or no population to be served. They certainly do not represent areas where widespread wireless deployment is possible or would be anticipated.

To further illustrate this point, we applied the same methodology described in the LEARN workshop to plot another station where the terrain is not a factor in determining potential for interference from a DTV stations to a wireless base station. The station used in the plot below is located in Chicago, Illinois, and has approximately the same technical parameters as the Johnstown, Pennsylvania station. It was chosen because the terrain in this part of the country is essentially flat. It should also be noted that in this case the blue contour has approximately the same radius as the Johnstown station.

These two examples suggest that a straightforward contour calculation does not produce meaningful inefficiencies as compared to the unduly complex and computationally intensive OET methodology. Contrary to OET's assertions, a separation distance approach is not spectrally inefficient in any meaningful sense, and the proposed methodology will not produce significant additional spectrum. The proposed OET methodology should be abandoned and replaced with a simple contour separation distance approach, discussed in Section VI below. The Joint Broadcasters also believe that providing wireless bidders with simple information such as actual separation distances to co- and adjacent-channel DTV stations is significantly more meaningful than providing bidders with misinformation regarding "impaired" or "restricted" areas based on complex calculations that use erroneous assumptions and assume unlikely hypothetical base station locations.

V. THE PROPOSED METHODOLOGY IS UNNECESSARILY COMPLEX BUT DOES NOT PROVIDE MORE ACCURATE RESULTS.

The *Public Notice* states that OET recognizes that the proposed methodology increases the complexity of the analysis and asks if the methodology strikes a more appropriate balance than the use of fixed co-channel and adjacent channel distances.[69] The answer is an emphatic no. While the methodology is undeniably complex, numerous inaccurate assumptions and clearly erroneous inputs, discussed above, overwhelm any theoretical marginal improvements in accuracy that use of the methodology might allow. The proposed methodology uses hypothetical wireless base stations located at hypothetical locations operating at hypothetical transmit powers and antenna heights that are considerably less than permitted under the rules; and, the number of these hypothetical base stations is limited due to computational constraints. None of the assumptions made by OET will yield a high degree of accuracy in modeling real world conditions, and the errors are cumulative. The proposed methodology will thus fail to provide greater accuracy or allow greater spectral efficiency than separation requirements, such as those already specified in Part 27 of the rules.[70]

To understand the tremendous complexity the proposed OET methodology introduces, consider how it will work in practice. The proposed methodology uses hypothetical base stations to calculate an interfering field strength taking into account the amount of spectral overlap with the DTV signal from +5 to -5 MHz and a number of other factors, such as clutter loss, antenna discrimination, and others. The proposed methodology suggests analyzing a 500 kilometer range for each DTV station. This 500

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[69] *Public Notice* at 4.
[70] *See* 47 C.F.R. §27.60.

kilometer range yields a total area of 785,398 square kilometers, or a total of 196,350 two-kilometer squares that have to be analyzed *for each station*.

Assuming a typical 90 kilometer radius coverage area for each DTV station yields an area of 196,360 square kilometers or 25,447 two-kilometer squares. In each of the 25,447 DTV service squares, the signal level of the DTV signal is calculated along with the relative angle of the DTV antenna towards the DTV transmitter. The DTV antenna is assumed to be correctly pointed at the DTV transmitter with directional gain to discriminate against off-axis undesired wireless signals. The antenna gain and pattern assumed are drawn from the DTV service planning factors.

Within each wireless service area, wireless base stations are uniformly spaced every ten kilometers. For a licensed service area such as an EA of about 20,000 square kilometers, this would mean about 1,000 hypothetical wireless base stations are assumed to be spaced uniformly every ten kilometers or every fifth two-kilometer square. The interfering fields from these base stations are calculated from each of these 1,000 hypothetical base stations taking into account the angle from the base station to each of the more than 25,000 DTV service area squares. This requires that in each square the desired TV signal is computed and the interfering base station signal is computed accounting for the angle of arrival of each signal and using the discrimination of the TV receive antenna to determine both the desired TV signal and the undesired wireless signal. This is repeated for *each wireless service area* within the 500 kilometer radius of the DTV station, or for approximately 200,000 two-kilometer squares for each of the approximately 2000 eligible DTV stations. This process would have to be repeated for *each* of the bidding rounds and stations as they are moved to new channels. The same process would also have to be applied for both the upper and lower adjacent channels.

All of this adds up to unnecessary complexity that has little relationship to the actual interference potential between wireless and broadcast operations in real-world deployments of wireless systems. In practice, TV viewers use wide arrays of TV receive antennas that can vary significantly from the DTV planning factors. The use of these antennas can affect whether a viewer receives interference. In addition, unlike the "hypothetical" wireless base stations assumed in the analysis, in practice, wireless base station locations are not uniformly spaced every ten kilometers, nor will all base stations operate at the greatly reduced power and antenna heights assumed in the proposed methodology. Since none of these "real world" conditions are taken into account, the analysis, while tremendously complex, misrepresents the potential for interference between broadcast and wireless operations that are likely to be implemented or that would be permitted under the proposed rules.

The *Public Notice* also fails to set forth an adequate cost-benefit analysis of OET's proposed methodology—a hallmark of arbitrary and capricious agency action.[71] The proposed methodology appears to be a variant of OET-69, which relies on the Longley-Rice radio propagation model.[72] In its *Public Notice*, however, OET does not even identify the specific changes made to OET-69, much less analyze their expected costs and benefits—a puzzling omission, given the Commission's stated interest in the costs and benefits of the incentive auction.[73] The *Public Notice*'s only allusion to costs and

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[71] *See, e.g.*, *Bus. Roundtable v. SEC*, 647 F.3d 1144, 1154-56 (D.C. Cir. 2011) (failure to consider costs and benefits of rule was arbitrary and capricious); *Am. Equity Inv. Life Ins. Co. v. SEC*, 613 F.3d 166, 179 (D.C. Cir. 2010) (failure to consider whether existing regime was sufficient was arbitrary and capricious).

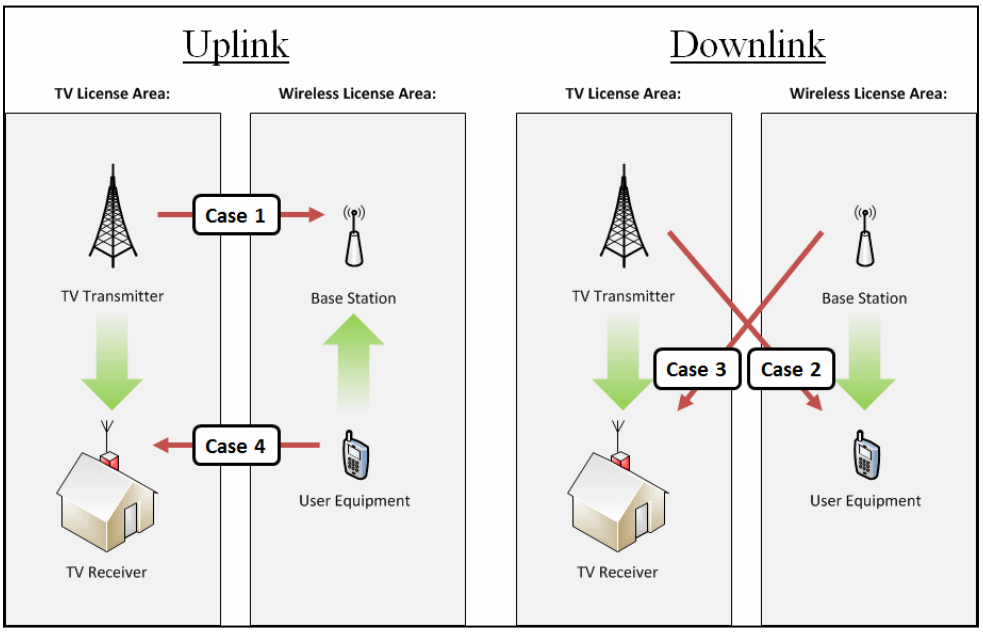
[72] *Public Notice* at 6 & n.11.

[73] *See, e.g.*, Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions, 77 Fed. Reg. 69934, 69946 (Nov. 21, 2012) ("For each of the options, the

benefits is a reference to OET's "concern" that interference-avoidance methods based on separation distances "may be spectrally inefficient and overly conservative," whereas the proposed methodology "could enable the Commission to accommodate market variation in a more spectrally efficient manner."[74] Those speculative and wholly unsupported musings do not pass APA muster as a reasoned analysis of costs and benefits.[75]

VI. THE JOINT BROADCASTERS PROPOSE AN ALTERNATE METHODOLOGY THAT WILL BE EASIER TO IMPLEMENT AND WILL NOT SACRIFICE EFFICIENCY.

The Joint Broadcasters agrees with OET's description of the four interference cases presented in the *Public Notice*:



As discussed above, developing a set of protected and interfering contours and geographic separations is far simpler and less computationally intensive than the

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Incentive Auctions NPRM seeks comment on the costs and benefits, including quantitative estimates, of each repacking option in comparison to the others").

[74] *Public Notice* at 4.

[75] *See, e.g.*, *Sw. Bell Tel. Co. v. FCC*, 28 F.3d 165, 172 (Fed. Cir. 1994) (Commission may not rely on speculative estimates of future costs and benefits).

proposed OET methodology and will yield similar results in terms of spectrum efficiency. This method can also be used in the auction process to determine whether wireless service areas are impaired or unimpaired based on simple contour overlap calculations. Using geographic overlaps, these contours can be used to determine the percent of the wireless service area impacted or impaired. Specifically, the Joint Broadcasters propose the following:

Case 1: Using the same methodology used to compute the DTV contour of a station, determine new co-channel and adjacent channel interference protection contours using the actual DTV station parameters, the FCC F(50,10) curves and the field strength limit values specified in Table 4 of the Appendix to the PN, adjusted by 3.5 dB to account for a height gain correction from 30 to 305 meters HAAT set forth in the proposed rules.[76] These contour distances could then be used to determine whether wireless operation on any channel or service area is unimpaired (*i.e.*, no interference contour overlap) or impaired and the percentage and location of any interference contour overlap.

Cases 2 and 4: The Joint Broadcasters concur with OET's assessment that Case 2, co-channel DTV transmitter-into-wireless user equipment (UE) downlink interference, is unlikely given the large separation distances needed for Case 1. For this reason, the Joint Broadcasters also agree that there is no significant risk of co-channel interference to DTV reception from wireless user equipment handsets (Case 4), provided adequate separation exists between the TV transmitter and the wireless base station.[77] We also agree with OET that in both cases adjacent channel interference is possible between

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[76] See *Table 4. Interference field strength values for DTV into wireless*, in the Appendix to the *Public Notice* at 19. The height gain correction for 30 meters to 305 meters for various interfering distances ranges between 3 and 4 dB. An average value of 3.5 dB was selected.

[77] *See*, *e.g.*, *Public Notice* at 4.

services. As noted in the *Public Notice*, the solution to both of these cases is to prohibit wireless user equipment from operating co-or adjacent-channel within some nominal distance of the protected contour of a DTV station.

The Joint Broadcasters proposes that co-channel wireless handset operations be prohibited within five kilometers of the contour of a co-channel DTV station[78] and that adjacent-channel wireless handset operations be prohibited within the contour of the adjacent-channel station. The Joint Broadcasters believes that this simple approach will protect both DTV viewers and wireless customers from interference and would adequately resolve Cases 2 and 4. We note that this is similar to the approach taken by the Commission with regard to unlicensed TV band devices that operate at similar power levels (100 mW) to wireless UE handsets.

Case 3: The Joint Broadcasters propose that the current rules in Section 27.60 should continue to be used for protection of DTV operations. To facilitate spectrum efficiency, distances would be based on actual TV operating facilities, so the distances would vary depending on the facilities of the stations involved. To determine the specific co- and adjacent-channel separation distances needed to avoid interference, the F(50, 10) curves would be used along with the D/U ratios specified in Table 8 of the Appendix to the *Public Notice* for specific channel or frequency overlaps.[79] Appropriate separation distances would be calculated using the desired DTV signal level (D) set to 41 dBµ (DTV

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[78] As noted in the *Public Notice*, there must be a large separation distance between the wireless base station and DTV transmitter, especially in the case of co-channel signals. Since the wireless service area is limited to the area around the base station, prohibiting UE operation within contours from which base stations must have significant distance separation will have little to no impact on actual UE operation.

[79] *See* Table 8, Threshold Interfering D/U Ratio for Wireless Base Station into DTV, *Public Notice* Appendix at 21.

contour) and the F(50,10) curves and D/U ratios using the maximum antenna height and transmitter power for the wireless base station permitted under the proposed wireless service rules. Wireless operation outside these distances would be deemed unimpaired.

The Joint Broadcasters continue to believe that a nationwide band plan is the soundest approach, and would avoid most of these interference issues. Nevertheless, if the Commission proceeds with a variable plan, the Joint Broadcasters urge the Commission to adopt a comprehensive approach that takes into account an appropriate band plan as well as realistic interference criteria. Developing a set of protected and interfering contours and geographic separations as the Joint Broadcasters propose would be far simpler than the proposed OET methodology, and will yield similar results in terms of spectrum efficiency. Most importantly, the Commission should adopt a band plan that avoids placing TV stations between the uplink and downlink in order to minimize interference to both DTV and wireless operations.[80]

VII. CONCLUSION.

The Commission must not use the proposed OET methodology as a basis for repacking, and it should not use the proposed OET methodology as a basis for predicting interference to provide information to wireless bidders in the forward auction. Use of the proposed methodology as a basis for repacking broadcast television stations would violate the express terms of the Spectrum Act. Such use would be legally unsustainable, and would risk upending or significantly delaying the auction. The proposed methodology systematically underestimates inter-service interference due to its reliance on clearly erroneous inputs and technically unsound assumptions.

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[80] *See* Letter from Rick Kaplan, NAB, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 12-268 (filed Jul. 10, 2013).

The Commission should reject the proposed methodology, and instead use a far simpler, more accurate model based on protected and interfering contours. This approach will prove far easier to implement. It also will provide wireless bidders with significantly greater certainty that they actually will be able to deploy networks operating on the spectrum they win in the forward auction in accordance with the Commission's service rules and interference protection criteria.

A micrometer is capable of making more accurate measurements than a tape measure. That does not mean it is a better or more accurate tool for measuring the height of a building. The proposed methodology may give the appearance of greater precision – yet, in application, the use of clearly erroneous inputs and assumptions, some of which are used only due to computational limits, will produce errors that overwhelm any potential increases in marginal accuracy associated with OET's more granular approach to predicting interference. The proposed OET methodology introduces significant additional complexity and does not provide more accurate results. In short, in this instance, OET's reach exceeds its grasp.

Respectfully submitted,

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CBS TELEVISION NETWORK AFFILIATES ASSOCIATION
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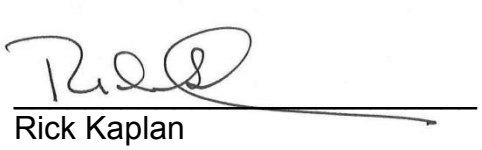

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