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

In the Matter of *Expanding the Economic and Innovation Opportunities of Spectrum through Incentive Auctions*	GN Docket No. 12-268 ET Docket No. 14-14

COMMENTS OF 4G AMERICAS

Introduction

4G Americas submits these brief Comments principally to support the Office of Engineering and Technology ("OET") in seeking to supplement the record regarding its proposed methodology for predicting potential interference between licensed wireless services and broadcast television in the UHF band, in the context of the incentive auctions. 4G Americas is the leading industry association in the Americas representing the 3GPP family of technologies, including LTE and LTE Advanced.[1] Around the world, where deployed, LTE has most often been deployed in new spectrum. Therefore, as an organization dedicated to promoting, facilitating, and advocating for 3GPP technology adoption throughout the Region, 4G Americas has a strong interest in a successful outcome in the broadcast incentive auctions.

[1] The 4G Americas Board of Governors members include Alcatel-Lucent, America Movil, AT&T, Cable & Wireless, Cisco Systems, CommScope, Entel, Ericsson, HP, Mavenir, Nokia Solutions and Networks, Openwave Mobility, Qualcomm, Rogers, T-Mobile USA, and Telefonica.

On January 29, 2014, the Commission released a Request for Comment from OET in which it seeks comment on a methodology that is an alternative to pre-defined separation distances for predicting potential interference between the two services.[2] 4G Americas applauds OET's effort to develop a more precise tool for predicting and preventing interference between mobile broadband and broadcast services. The mobile industry's demand for more spectrum below 3.7 GHz is acute. Spectrum below 1 GHz is especially valuable to the mobile industry. The FCC should carefully consider ways to maximize mobile service access to the spectrum at 600 MHz. 4G Americas takes no position on the Commission's goal of accommodating mobile market variation, but rather focuses on the goal of developing a more precise method of predicting and preventing inter-service interference, in order to maximize efficiency of this high-demand resource.

Discussion

4G Americas notes that inter-service interference will require the Commission's attention regardless of the degree of broadcaster participation in the incentive auction, due to continued television transmissions in the 600 MHz band along the border in Mexico and Canada. Hence, in any event, it is important for the Commission to develop a more precise methodology than pre-defined separation distances. Much has been written about the soaring demand for and economic benefits of mobile broadband.[3] Global mobile data traffic has been doubling during each of the

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[2] *Office of Engineering and Technology Seeks to Supplement the Incentive Auction Proceeding Record Regarding Potential Interference Between Broadcast Television and Wireless Services*, Public Notice, DA 14-98, 29 FCC Rcd. 712 (OET 2014) ("*Public Notice*").

[3] *See, e.g., Cisco Visual Networking Index: Forecast and Methodology, 2012-2014* (May 29, 2013), *available at* http://www.cisco.com/c/en/us/solutions/collateral/service-provider/ip-ngn-ip-next-generation-network/white_paper_c11-481360.pdf; *Ericsson Mobility Report*, http://www.ericsson.com/mobility-report (last visited March 17, 2014); Deloitte, *The impact of 4G technology on commercial interactions, economic growth, and U.S. competitiveness* (August 2011), *available at* http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/TMT_us_tmt/us_tmt_impactof4g_edited060612.pdf.

last few years, and this growth is projected to continue unabated due to consumer uptake of larger screen devices, video-rich tablets, machine-to-machine applications, and, soon, the connected vehicle and home.[4]

Given this growth, it is in the public interest for the Commission to develop the most precise tool for preventing inter-service interference and minimizing wireless market impairment. Such a methodology will increase spectral efficiency and ensure that any mobile use introduced to the 600 MHz band is delivered with the quality-of-experience expected by consumers. Moreover, a predictive methodology will provide wireless carriers and broadcasters with better information prior to the commencement of the auction, resulting in a more economically efficient outcome.

In Figure 1 of its Notice, copied below, OET diagrams four interference case scenarios: 1) the TV transmitter to the mobile base station ("case 1"); 2) the TV transmitter to the mobile user equipment ("UE" or "case 2"); 3) the mobile base station to a viewer's TV receiver ("case 3"); and 4) the mobile user equipment to a TV viewer's receiver ("case 4").[5]

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[4] 4G Americas, *Meeting the 1000x Challenge: The Need for Spectrum, Technology and Policy Innovation*, at 6 (October 2013), *available at* http://www.4gamericas.org/documents/2013_4G%20Americas%20Meeting%20the%201000x%20Challenge%2010%204%2013_FINAL.pdf.

[5] *See Public Notice*, 29 FCC Rcd. at 714, Figure 1 (copied infra).

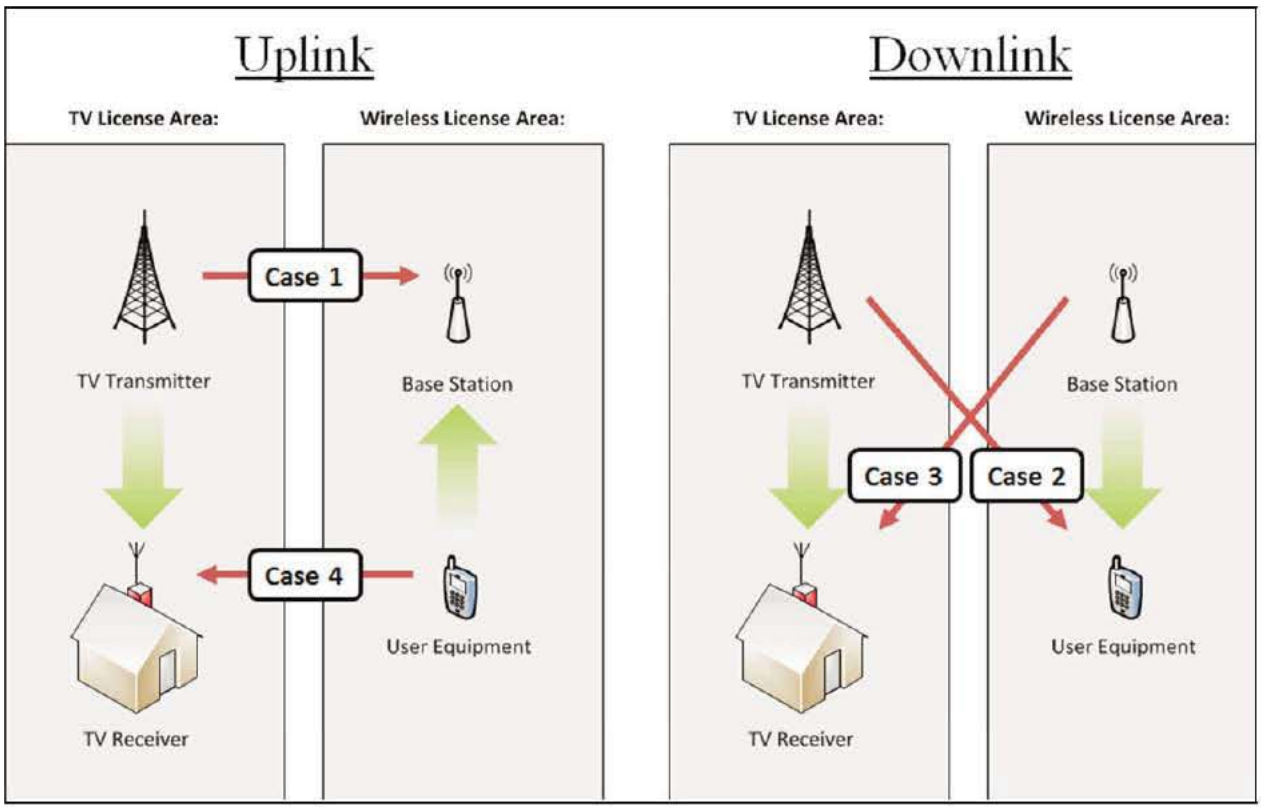

Figure 1. Interference scenarios

The four interference case scenarios adequately capture the interference possibilities between the two services. 4G Americas agrees with OET that there is no significant risk of co-channel interference to DTV reception from mobile user equipment.[6] OET correctly notes that advances in mobile technology, such as Multiple-Input Multiple-Output (MIMO) antenna technology and resource block provisioning, will enable mobile operators to mitigate potential interference.[7] Recent advancement in 3GPP standards, including in Self-Optimizing Networks and interference cancellation, will enable operators to deliver mobile broadband with more spectral efficiency

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6 *See id.* at 715.

7 *Id. See also, e.g.,* 4G Americas, *Self-Optimizing Networks in 3GPP Release 11: The Benefits of SON in LTE*, at 15, Section 3.6 (October 2013), *available at* http://www.4gamericas.org/documents/Self-Optimizing%20Networks-Benefits%20of%20SON%20in%20LTE_10.7.13.pdf ("*SON Release 11 White Paper*") (LTE allows for Random Access Channel Optimization, which allows operators to automate balancing "the radio resource allocation between random accesses and services while at the same time avoiding the creation of excessive interference.")

than previously possible.[8] 4G Americas agrees with OET that the Commission should not establish a generic "one-size-fits-all" separation distance to cover the four interference scenarios, as was done in Part 27.60 of the Commission's Rules. OET's proposed methodology is a fundamentally sound approach to predicting and preventing the possibility of interference between LTE broadband service and ATSC broadcast television service.

Methodology to Determine Wireless Interference to DTV

Rather than use predetermined separation distances, the OET Methodology proposes to use a combination of 1) the Longley-Rice model for predicting radio signal propagation losses; 2) established planning factors and industry standards to determine thresholds of coverage and interference; 3) typical specifications where industry standards to do not exist; and 4) commonly-used protocols, databases, and propagation models.[9]

The Commission asks whether calculation of the desired-to-undesired transmissions (D/U) ratio values on a 2 kilometer grid with mobile base stations spaced uniformly at 10 kilometers will provide sufficient resolution when determining possible interference.[10] Assuming a uniform distribution of wireless base stations is appropriate for this input into OET's predictive model. Use of a generic grid with base stations uniformly spaced at 10 km intervals is not a perfect predictor of real-world network deployment, but that model may provide sufficient

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8 *See SON Release 11 White Paper* at 12-13, Section 3.5 (Mobility Robustness Optimization (MRO) minimizes hand-off and radio link failures and Mobility Load Balancing (MLB) spreads user traffic across a system's radio resources to optimize capacity while maintaining quality); *see also id.* at 16-18, Section 3.7.1 (eICIC allows the intelligent coordination of physical resources between neighboring cells to reduce inter-cell interference by each cell giving up the use of some resource in a coordinated fashion).

9 *Public Notice*, 29 FCC Rcd. at 721.

10 *Id.* at 716.

resolution, based on computer processing limitations for this particular context of predicting interference.

The Commission also asks for comment on how to define the acceptable interference to a DTV station and resultant impact on the population within a given wireless market.[11] 4G Americas believes interference from wireless service predicted within the DTV service contour should be treated the same way that inter-DTV service is considered and the levels contemplated in the Notice of Proposed Rulemaking—2% of the population impacted—be permitted.[12] As a corollary, possible interference from wireless services predicted outside of the DTV service contour should be ignored and not considered in a predictive methodology.

Technical Assumptions

Given the difference in wireless and broadcast channel bandwidths, 5 MHz and 6 MHz respectively, the channels will indeed not perfectly align post auction. The Commission appropriately notes that the varying degree of spectral overlap between DTV and mobile services will significantly impact the potential for co-channel and adjacent-channel interference between the two services.[13] The Commission invites comment on whether the total power in the spectral overlap should be used in assessing interference.[14] 4G Americas agrees with OET's consideration of overlapping DTV and LTE blocks. A single television channel may indeed overlap two wireless channels in a nearby wireless license area, and the different amounts of

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[11] *Id.* at 718.

[12] *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Notice of Proposed Rulemaking, FCC 12-188, 27 FCC Rcd. 12,357, 12,395-96 ¶ 108 (2012).

[13] *Public Notice*, 29 FCC Rcd. at 717.

[14] *Id.*

spectral overlap should be reflected in any protection requirements.[15] While OET's more specific predictive modeling may indeed increase the complexity when compared with simple separation distances, the resulting increase in spectrum availability and spectral efficiency justify that additional complexity. 4G Americas also agrees that because wireless services are expected to be noise-like, and studies have shown that noise-like signals have interference potential nearly identical to DTV, that the existing DTV protection criteria can generally be applied.[16] 4G Americas therefore agrees that treating LTE as noise-like interference to ATSC is technically sound.

Propagation

OET proposes using the Institute of Telecommunications Science's Irregular Terrain Model ("Longley-Rice") for predicting radio signal propagation loss in its inter-service interference model.[17] The Commission seeks comment on whether applying Longley-Rice is an appropriate propagation model for some or all of the four interference scenarios.[18] The Commission also seeks suggestions for specific alternative models and whether the consideration of clutter is appropriate (and, if so, appropriate clutter losses for interference cases involving user equipment).[19]

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15 *Id.* at 716.

16 *See id.* at 727-28.

17 *See* OET Bulletin No. 69 (Feb. 6, 2004), *available at* http://transition fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet69/oet69.pdf; OET Bulletin No. 72 (July 2, 2002), *available at* http://transition fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet72/oet72.pdf; OET Bulletin 73 (Nov. 23, 2010), *available at* http://transition fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet73/oet73.pdf; *see also Public Notice*, 29 FCC Rcd. at 721.

18 *Public Notice*, 29 FCC Rcd. at 717.

19 *Id.*

4G Americas agrees with OET that the Longley-Rice model is appropriate to predict ATSC signals over long-distances for interference cases 1 and 2 (DTV transmitters to LTE base stations and to mobile user equipment). However, introducing clutter in the predictive methodology for case 2 (DTV receiver into mobile UE) would increase the accuracy of the prediction. Use of Longley-Rice F(50,50) is likewise appropriate for case 2 because current and planned LTE deployments do have improved features that better enable mobile user devices to reject interference, such as operator deployment of Multiple-Input Multiple-Output (MIMO) antennas, inter-cell interference coordination, and the ability to schedule resource blocking and provisioning.[20] Mobile broadband operators using Self-Optimizing Network techniques will be able to move off spectrum more quickly when needed, falling back to other channels as needed.[21] The 3GPP standards enables cells to expand and contract their coverage areas as needed to avoid interference with one another and to instantly recognize new cells and incorporate them into the carrier's network.[22] And LTE devices have embedded mitigation interference cancellation technology.[23]

The Commission asks whether there are variations of the OET Methodology or other approaches that would better address the balance between spectrum efficiency and interference

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[20] *See SON Release 11 White Paper* at 13, Section 3.5.2.1; 16, Section 3.7; 25-26, Section 3.11.

[21] *See id.* at 11, Section 3.3.1; 12-13, Section 3.5 (Mobility Load Balancing can be used to automatically shape the system load according to operator policy or to empty lightly loaded cells which can then be turned off in order to save energy; moreover, Physical Cell Identity (PCI) allows operators to optimize performance and resolve possible PCI collisions by early detection and alerting the OSS. The centralized SON entity will reassign codes to minimize collisions).

[22] *Id.* at 8, Section 3.2; 33, Section 4.2.1.3 (Automatic Neighbor Relation is one of the most important features of SON, allowing operators networks to discover neighboring cells and add them to the Neighbor Relation Table ("NRT") under OAN guidance).

[23] Under LTE standards, mobile user equipment (UEs) report the signal strength from a neighboring cell. If the UE's serving cell has not seen this neighbor before, it will request and the UE will perform System Information Acquisition for the neighbor, and the serving cell adds this neighbor to its NRT.

protection.[24] For modeling LTE emissions over shorter distances from LTE Base stations and UEs to DTV receivers (interference cases 3 and 4), 4G Americas suggests use of the Okumura-Hata propagation model ("Hata model").[25] The Hata model was originally developed for non-Line-Of-Sight (Non-LOS) paths in urban environments typical of mobile services—that is with low-height mobile terminals moving in cluttered environments. Therefore, introducing clutter would increase the accuracy of the predictions for both cases 3 and 4, as well as for case 2. The Hata model was designed for use in the frequency range between 30 MHz up to 3 GHz and for shorter distances of 0 – 40 km. In theory, the Hata model can accurately be applied to predict loss up to 100 km since the curvature of the earth is included in the propagation calculation, but in practice its use is recommended for distances up to 40 km. At longer distances, Longley-Rice and Hata might produce similar results. 4G Americas therefore supports the use of Longley-Rice for predictive modeling for long distances. But for propagation distances of 40 km and less, 4G Americas suggests the Commission use the Hata model for its inter-service interference predictive methodology.

With respect to the question of whether to exclusively use macro cells in the predictive methodology, 4G Americas supports OET's proposal. OET's use of macro cells in its model is appropriate, since regardless of whether mobile operators ultimately deploy a mixture of macro and small cells at 600 MHz, signals from the higher-powered macro cells will more accurately predict and protect against worst-case scenarios of interference to DTV receivers.

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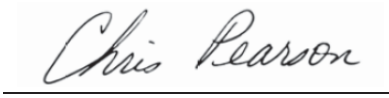
[24] *Public Notice*, 29 FCC Rcd. at 715.

[25] *See, e.g.*, Andreas F. Molisch, Wireless Communications, Appendix 7.A (2nd ed. 2011), *available at* http://www.wiley.com/legacy/wileychi/molisch/supp2/appendices/c07_Appendices.pdf.

Conclusion

4G Americas commends the Commission for seeking comment on the OET Methodology. 4G Americas shares the Commission's goals of spectral efficiency. With the alternative suggested above—use of the Hata propagation model to introduce clutter in the model for predicting interference relative to mobile user equipment—4G Americas agrees that the information provided by OET's methodology should empower participants in the auction to better determine whether a wireless market is impaired.[26] This information should result in a more economically and spectrally efficient auction.

Respectfully submitted,



Chris Pearson
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March 17, 2014

[26] The Commission should consider however whether and how this impairment affects the fungibility of spectrum blocks in the auction design and how this information is conveyed to auction participants.