

Before the  
**FEDERAL COMMUNICATIONS COMMISSION**  
Washington, DC 20554

In the Matter of

Amendment of the Commission's Rules with )  
Regard to Commercial Operations in the 1695- ) GN Docket No. 13-185  
1710 MHz, 1755-1780 MHz, and 2155-2180 )  
MHz Bands )

To: The Commission

**REPLY COMMENTS OF  
THE BOEING COMPANY**

The Boeing Company (“Boeing”) provides these reply comments in response to the Commission’s Notice of Proposed Rulemaking (“NPRM”) regarding spectrum for the Advanced Wireless Service (“AWS-3”).<sup>1</sup> In its initial comments, Boeing explained at length the critical role of the Tracking and Data Relay Satellite System (“TDRSS”), which operates in the 2025-2110 and 2200-2299 MHz bands, and the need to ensure that operation of AWS-3 Long Term Evolution (“LTE”) services do not impair access to TDRSS.<sup>2</sup> Boeing focused in particular on a NASA feasibility study that analyzed the potential for sharing between TDRSS and concluded that “[e]ven with the wide range of parameters and very favourable sharing assumptions...the amount of interference is so excessive that additional interference mitigations cannot sufficiently

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<sup>1</sup> Amendment of the Commission’s Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands, GN Docket No. 13-185, FCC 13-102 (2013) (“*NPRM*”).

<sup>2</sup> Comments of The Boeing Company, GN Docket No. 13-185 (Sept.18, 2013).

reduce interfering signal levels to enable sharing.<sup>3</sup> Because of the vital role of TDRSS in current and future government and commercial space operations, and because some commenters have disputed the methodology and conclusions of the NASA assessment, Boeing provides these reply comments to highlight an updated version of the feasibility study and reiterate that even under very favorable sharing assumptions based on the best available data, LTE services as currently proposed are not compatible with TDRSS operations in the 2025-2110 MHz band. Boeing therefore urges the Commission to refrain from considering any high-density commercial wireless allocation in the 2025-2110 MHz band used for TDRSS.<sup>4</sup>

**I. NASA’S SUBMISSIONS TO JTG 4-5-6-7 CONSISTENTLY AND CORRECTLY DEMONSTRATE THAT LTE CANNOT BE ACCOMMODATED IN THE 2025-2110 MHZ BAND**

The July 12, 2013 NASA feasibility assessment (“NASA Study”) was entered into the record of this proceeding by the NTIA and also submitted to the ITU-R Joint Task Group 4-5-6-7 (“JTG4-5-6-7”).<sup>5</sup> The NASA Study relied on preliminary technical parameters for LTE systems developed by the 3rd Generation Partnership Project (“3GPP”) and provided to ITU-R Working Party 5D. Where certain LTE system parameters were not yet agreed by Working Party 5D, the study utilized parameters developed by the Commerce Spectrum Management Advisory

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<sup>3</sup> Letter from Karl B. Nebbia, Associate Administrator, Office of Spectrum Management, NTIA, to Julius P. Knapp, Chief, Office of Engineering and Technology, FCC, at 1-2 (July 22, 2013) (GN Docket No. 09-51, ET Docket 10-123) (“*NTIA July 2013 Letter*”). See also *id.*, Enclosure 2 (United States of America, Feasibility Assessment for Accommodation of Mobile Broadband Long Term Evolution (LTE) Systems in the 2 025-2 110 MHz Band, Document 4-5-6-7/170-E, at 16 (dated 16 July 2013)).

<sup>4</sup> Boeing’s initial comments also joined with the Aerospace & Flight Test Radio Coordinating Council (“AFTRCC”) in urging the Commission not to consider use of the 2360-2395 MHz Aeronautical Mobile Telemetry (“AMT”) band for LTE. Boeing reasserts its opposition to any LTE allocation in the 2360-2390 MHz band, but focuses this reply on the TDRSS band.

<sup>5</sup> *NTIA July 2013 Letter* at 1-2.

Committee (“CSMAC”).<sup>6</sup> At the close of the July meeting of JTG4-5-6-7, it was determined that the feasibility assessment needed to be updated based on the new definitive set of LTE system parameters for use in frequency sharing studies provided by Working Party 5D.<sup>7</sup> Accordingly, NASA used these updated parameters to revise the NASA Study and produce an updated version for submission to the October 2013 meeting of JTG4-5-6-7 (the “Updated Study”).

Subsequently, some proponents of LTE asserted that the NASA Study was flawed, in particular because it incorporated “worst-case, conservative assumptions” and mischaracterized LTE systems contemplated for the 2025-2110 MHz band.<sup>8</sup> In fact, the NASA Study employed a range of assumptions including normal, best case, and worst case sharing scenarios, and characterized LTE systems according to the then most recent available data. As a result, the methodology and conclusions of the NASA Study represented the most accurate analysis available at the time. The Updated Study, however, begun shortly after the release of the NASA Study, revised many of the parameters criticized by the LTE proponents. As the comments of Ericsson acknowledge “[w]hile some revisions may partially address the concerns we outline below, there was simply not enough time to review the new document prior to filing the instant Comments.”<sup>9</sup> The revised parameters employed in the Updated Study resulted in significantly more favorable assumptions regarding sharing, but even under the revised frequency sharing

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<sup>6</sup> *NASA Study* at 2.

<sup>7</sup> United States of America, Proposed Updates to Preliminary Draft New Report ITU-R SA [2,025-2,290 MHz], Document 4-5-6-7/337-E, at 1 (10 July 2013) (“*Updated Study*”).

<sup>8</sup> See Comments of CTIA – The Wireless Association, GN Docket 13-185 at 17 (Sept.18, 2013) (“*CTIA Comments*”); see also Comments of Ericsson, GN Docket 13-185 at 14 (Sept.18, 2013) (“*Ericsson Comments*”); Comments of T-Mobile, GN Docket 13-185 at 27 (Sept.18, 2013) (“*T-Mobile Comments*”).

<sup>9</sup> *Ericsson Comments* at 14.

parameters, the Updated Study continues to show that sharing between TDRSS and LTE systems in the 2025-2110 MHz is not feasible.<sup>10</sup>

**A. Frequency Sharing Remains Infeasible Even Under the Considerably More Favorable Assumptions Employed in the Updated Study**

Below, Boeing highlights several of the many ways in which the Updated Study anticipated and addressed the criticisms raised by the LTE proponents.

Geographic Deployment of Base Stations: CTIA asserts that the NASA Study assumed a far greater number of base stations than would be present in the real world deployment, and that the actual base stations would be less evenly distributed.<sup>11</sup> T-Mobile suggests that the NASA Study materially overestimates the number of LTE cells by failing to use the inter-site distance agreed to by the CSMAC working groups.<sup>12</sup> Ericsson states that actual inter-site distances would be more diverse than those assumed in the NASA Study.<sup>13</sup> In fact, both the NASA Study and the Updated Study applied inter-site distances specified by CSMAC Working Group 1 (“WG1”).<sup>14</sup> The NASA studies did deviate from the WG1 specifications, however, by reducing the assumed coverage areas in and around each city to one fourth the size of those specified by WG1, consequently reducing the number of base stations per city as compared to the WG1 parameters, and presenting a more optimistic case for LTE sharing. Even with these reductions, however, the LTE base station signal power would still substantially exceed the protection criteria for TDRSS.

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<sup>10</sup> *Updated Study* at 28.

<sup>11</sup> *CTIA Comments* at 17.

<sup>12</sup> *T-Mobile Comments* at 22-23.

<sup>13</sup> *Ericsson Comments* at 14-15.

<sup>14</sup> *See* Commerce Spectrum Management Advisory Committee, Final Report, Working Group 1 – 1695-1710 MHz Meteorological-Satellite, (Jan.22, 2013), Appendix 3, “Baseline LTE Uplink Characteristics.”

The Updated Study also reduced the number of cities being considered worldwide, from 349 cities of various sizes, to only the largest 160 of those cities by population.<sup>15</sup> This change was offset, however, by the reduced inter-site spacing distances specified by the updated parameters from ITU Working Party 5D.

Base Station Transmitter Power Levels: LTE proponents also argue that a uniform 40 watt power level assumed for base stations is “unrealistically and extraordinarily large.”<sup>16</sup> In fact, the NASA Study employed the 40 watt power level to represent a “peak power level” corresponding to 100 percent traffic loading, and also considered traffic loading of 50 percent and 10 percent.<sup>17</sup> The Updated Study halved the maximum assumed resource loading, to 50 percent, and reduced the next step by more than half, down to 20 percent.<sup>18</sup>

Base Station Down-Tilt Angles: Ericsson states that by applying a 3 degree down-tilt for all sector antennas, the NASA Study did not adequately account for the increased down-tilt of base station antennas in urban and suburban areas.<sup>19</sup> The Updated Study incorporated the down-tilt specifications provided by ITU-R Working Party 5D, varying down from 3 degrees in rural areas to 6 degrees in suburban areas and 10 degrees in urban areas.<sup>20</sup>

Base Station Propagation Characteristics: Ericsson and T-Mobile assert that the NASA Study accounted insufficiently for the mitigating effect of clutter loss and shielding of signals.<sup>21</sup>

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<sup>15</sup> *Updated Study* at 10.

<sup>16</sup> *T-Mobile Comments* at 23; *Ericsson Comments* at 14-15.

<sup>17</sup> *NASA Study* at 7, Table 2.

<sup>18</sup> *Updated Study* at 9 (Table 4, LTE base station technical characteristics).

<sup>19</sup> *Ericsson Comments* at 15.

<sup>20</sup> *Updated Study* at 9.

<sup>21</sup> *Ericsson Comments* at 15.

The NASA Study assumed a signal attenuation for angles of 5 degrees and below, increasing to a maximum attenuation of 16 dB at -3 degrees.<sup>22</sup> The Updated Study applied significantly more favorable parameters, assuming three cases: hypothetical complete site shielding of signals on paths having elevation angles below 0, 20, and 45 degrees.<sup>23</sup>

Aggregate Handset Power Per City: T-Mobile asserts that the NASA Study assumed unrealistically high numbers of transmitting handsets, and correspondingly high aggregate per-city handset transmitter power levels.<sup>24</sup> The NASA Study relied on the number of handsets specified by CSMAC Working Group 1, prior to the release of updated specifications by Working Party 5D. The Updated Study estimates of the number of handsets per base station in accordance with the parameters provided by Working Party 5D. In this manner, the Updated Study addresses the concerns of wireless carriers that were raised about the initial NASA Study.

**B. AWS-1 is Not Predictive of the Interference Potential of AWS-3 to TDRSS Operations**

Some commenters suggest that, if the NASA study accurately identifies the interference potential of LTE systems in the 2025-2110 MHz band, then TDRSS systems should already be experiencing some level of interference from existing AWS-1 operations at 2109.49 MHz, which overlap partially with the TDRSS spectrum.<sup>25</sup> This argument is inapposite because it considers a service that operates at the very edge of the TDRSS forward link channel, which is centered at 2106.41 MHz, as compared to the proposed operation of co-channel AWS-3 base stations from

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<sup>22</sup> *NASA Study* at 7, Table 2.

<sup>23</sup> *Updated Study* at 9, Table 4.

<sup>24</sup> *T-Mobile Comments* at 22.

<sup>25</sup> *CTIA Comments* at 17, *Ericsson Comments* at 17.

2095-2110 MHz.<sup>26</sup> TDRSS user satellites are designed to reject signals above 2110 MHz, and thus achieve substantial rejection from AWS-1 transmitters operating primarily above 2110 MHz, an adaptation not possible with the proposed AWS-3 operations directly in the 2025-2110 MHz band. As a result, the limited potential for interference from primarily out-of-band emissions by existing AWS-1 operations has no relevance to the potential for co-channel interference from proposed AWS-3/LTE systems in the 2095-2110 MHz band.

**C. Footnote 5.391 Continues to Prohibit the Introduction of High-Density Mobile Systems in the 2025-2110 MHz and 2200-2290 MHz Bands**

Finally, the NPRM appropriately acknowledges that Footnote 5.391 maintains the existing international prohibition on high density mobile systems in the 2025-2110 MHz band.<sup>27</sup> None of the LTE proponents responded to the Commission's question as to how to reconcile proposals for LTE in the band with the clear, and justified, prohibition in the footnote. As the Commission is well aware, international footnotes represents a treaty obligation of the United States. The Commission should therefore give substantial weight to this longstanding prohibition, which represents the considered consensus of the international community as to both the importance of existing space operations and the infeasibility of space operations successfully sharing the band with high density terrestrial mobile systems.

**II. CONCLUSION**

The proposed LTE services cannot feasibly share spectrum with existing TDRSS operations in the 2025-2110 MHz band even when considered using a substantial range of assumed operating parameters. The Updated Study anticipated and resolved many of the LTE

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<sup>26</sup> *NPRM*, ¶ 20.

<sup>27</sup> *Id.*, ¶ 39.

proponents criticisms of the NASA Study, and in doing so analyzed a range of scenarios based on the best available estimates for LTE operation. Even under the more favorable revised parameters, the NASA study continues to conclude that the “level of interference exceeds the permissible criteria by so much that additional interference mitigations cannot sufficiently reduce interfering signal levels to enable sharing.”<sup>28</sup> This conclusion is not affected by the lack of significant interference from AWS-1 operations because adjacent channel AWS-1 operations are not predictive of the interference potential of co-channel AWS-3 service. Finally, the Commission should give appropriate weight to Footnote 5.391, which provides a longstanding prohibition on the introduction of high-density mobile systems in the 2025-2110 MHz and 2200-2290 MHz bands. For these reasons, Boeing urges the Commission to refrain from considering any high-density commercial wireless allocation in the 2025-2110 MHz band used for TDRSS.

Respectfully submitted,

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<sup>28</sup> *Updated Study* at 28.