

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

In the Matter of )  
 )  
Expanding Flexible Use in Mid-Band ) GN Docket No. 17-183  
Spectrum Between 3.7 and 24 GHz )

To: The Commission

## REPLY COMMENTS OF THE BOEING COMPANY

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## SUMMARY

The comments that have been filed in this proceeding demonstrate the importance for the Commission to continue to protect numerous critical communications services operating in the 3.7-4.2 GHz and the 5.925-7.125 GHz bands. C-band satellite services provide essential and often irreplaceable communications services operating on a paired basis in the 3.7-4.2 GHz and the 5.925-6.425 GHz bands. These satellite networks are used for a large number of critical services that often could not be provided in a reliable or efficient manner using other spectrum bands or using non-satellite communications technology. The Commission should therefore proceed very cautiously in considering the proposal of Intelsat and Intel to develop a voluntary process to permit operators of C-band satellite networks to negotiate commercial agreements with wireless interests to relocate earth stations out of portions of the C-band.

The 3.7-4.2 GHz and the 5.925-7.125 GHz bands are also increasingly being used for the operation of ultra-wideband (“UWB”) communications services that support many novel applications in the United States that could not be achieved using other types of wireless communications services or frequency bands. Numerous parties have filed comments in this proceeding identifying innovative UWB applications and technologies that are being employed in industry and in consumer services. For example, Boeing uses UWB technology to operate an asset tracking system inside each of its aircraft manufacturing facilities to monitor the locations of tools and equipment.

The Commission must also ensure that any additional use within the 3.7-4.2 GHz band fully protects aircraft radio altimeter and wireless avionics intra-communications (“WAIC”) systems that operate in the immediately adjacent 4.2-4.4 GHz band. Both of these services are essential to the effective operation of aircraft and the safety of the flying public.

Finally, the Commission should complete its allocation of spectrum in the 4.400-4.940 and 5.925-6.700 GHz bands for aeronautical mobile telemetry services to support the rapidly growing spectrum requirements of FAA-mandated flight test operations.

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**REPLY COMMENTS OF  
THE BOEING COMPANY**

The Boeing Company (“Boeing”) herein replies to certain of the comments that were filed in response to the Commission’s Notice of Inquiry (“NOI”) on expanding flexibility for wireless systems in frequency bands between 3.7 and 24 GHz.

**I. THE COMMISSION MUST CONTINUE TO PROTECT CRITICAL SATELLITE COMMUNICATIONS SERVICES IN THE C-BAND**

As Boeing indicated in its comments, Boeing strongly supports the comments that were filed by the Satellite Industry Association (“SIA”) providing tremendous detail on the critical importance and ongoing use of satellite communications networks operating on a paired basis in the 3.7-4.2 GHz and the 5.925-6.425 GHz bands. These satellite networks are used for a large number of critical services that often could not be provided in a reliable or efficient manner using other spectrum bands or using non-satellite communications technology.

For example, the aviation industry uses C-band satellite communications services to transmit Air Traffic Management (“ATM”) data between airports and remote aviation communications sites that are often not accessible to terrestrial networks. As noted by Aviation Spectrum Resources, Inc. (“ASRI”), these highly reliable C-band communications links have enabled nationwide deployment of VHF ground-to-air voice and datalink communications to

support the operation of the United States Airspace System.<sup>1</sup> C-band satellite communications systems are also used for the nationwide distribution of NOAAPORT, a dedicated weather data feed produced by the National Oceanic and Atmospheric Administration (“NOAA”) that is used to support aviation and other purposes that depend on detail information regarding significant weather events.

Disaster relief services also depend on portable earth station terminals operating in the C-band to rapidly establish and maintain emergency communications links that benefit from low rain attenuation and are therefore highly reliable in adverse weather conditions. Satellite networks operating in the C-band are also used continuously to distribute news, entertainment and informational programming to television stations, cable system headends, and other facilities for subsequent distribution to consumers. These broadband distribution links require extreme reliability in order to transmit digital HDTV programming, and the C-band frequencies under consideration by the NOI are optimal for this purpose.

In raising these concerns, Boeing acknowledges the proposal of Intelsat and Intel to develop a framework whereby operators of C-band satellite networks could work together with terrestrial spectrum users to relocate C-band earth stations out of certain geographic areas, or out of certain portions of the C-band. Boeing believes that the Intelsat/Intel proposal must be reviewed with significant caution to ensure that the development of a voluntary relocation or retuning process that may be suitable with respect to some C-band satellite spectrum uses does not become a compulsory process that could risk making the C-band unavailable for critical services that depend on these communications capabilities.

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<sup>1</sup> See Comments of Aviation Spectrum Resources, Inc., GN Docket No. 17-183, at 2 (Oct. 2, 2017) (“*ASRI Comments*”).

## **II. THE COMMISSION MUST CONSIDER MEASURES TO ENSURE THE CONTINUED OPERATION OF ULTRA-WIDEBAND TECHNOLOGIES IN EACH OF THE BANDS UNDER CONSIDERATION BY THE NOI**

The Commission's NOI seeks comment on the potential introduction of new fixed and mobile services in the 3.7-4.2 GHz, the 5.925-6.425 GHz and the 6.425-7.125 GHz bands,<sup>2</sup> with a particular focus on the potential for fixed<sup>3</sup> or mobile services<sup>4</sup> in the 3.7-4.2 GHz band, new unlicensed services in the 5.925-6.425 GHz band,<sup>5</sup> and additional fixed or mobile use in the 6.425-7.125 GHz band.<sup>6</sup>

In seeking comment on these issues, the NOI does not appear to acknowledge that the Commission has already authorized unlicensed services throughout each of these frequency bands. As a result of a lengthy and extremely comprehensive proceeding in the years between 2000 and 2004, the Commission authorized the operation of ultra-wideband ("UWB") communications services throughout the 3.1 GHz to 10.6 GHz bands. UWB technologies are now in use to support many critical applications in the United States that could not be achieved using other types of wireless communications services or frequency bands.

For example, Boeing uses UWB technology to operate an asset tracking system inside each of its aircraft manufacturing facilities to monitor the locations of more than ten thousand tools, carts and other equipment used in the aircraft assembly process. Each tracked device is equipped with an RF transmitter that emits a very low power UWB signal in the range of 6.35-

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<sup>2</sup> See *Mid-Band NOI*, ¶ 2.

<sup>3</sup> See *id.*, ¶ 18.

<sup>4</sup> See *id.*, ¶ 19.

<sup>5</sup> See *id.*, ¶ 26-29.

<sup>6</sup> See *id.*, ¶ 36.

6.75 GHz that penetrates walls and metallic surfaces and can be detected by UWB receivers placed within each manufacturing facility. The system ensures that Boeing is always able to locate the significant number of tools and equipment that are employed in the aircraft manufacturing process.

As indicated in the comments of other parties in this proceeding, UWB technologies are also used throughout the 3.1-10.6 GHz bands for numerous other innovative and important purposes that often could not be replicated using other spectrum bands or technologies.<sup>7</sup>

UWB systems operate using extremely low power and other technical and operational constraints that “are significantly more stringent than those imposed on other Part 15 devices” to ensure that UWB devices do not cause harmful interference to incumbent services in the 3.1-10.6 GHz bands.<sup>8</sup> Unfortunately, many of the technical constraints that ensure that UWB systems do not cause harmful interference to incumbent services also make UWB highly susceptible to interference from itinerant devices, such as licensed mobile devices, or non-UWB Part 15 devices operating at higher power levels. Thus, although UWB technologies are carefully designed to operate successfully in the presence of the incumbent spectrum uses that exist in

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<sup>7</sup> See, e.g., Comments of 3DB Access, GN Docket No. 17-183 (Nov. 12, 2017); Reply Comments of IEEE 802.15 Working Group, GN Docket No. 17-183 (Nov. 9, 2017); Reply Comments of Agilion GmbH, GN Docket No. 17-183 at 1-3 (Nov. 2, 2017); Reply Comments of NXP Semiconductors, GN Docket No. 17-183 at 1-2 (Nov. 1, 2017); Comments of Zebra Technologies, GN Docket No. 17-183, at 3-4 (Oct. 31, 2017); Comments of Novelda US, Inc., GN Docket No. 17-183 at 1-5 (Oct. 30, 2017); Reply Comments of Secure Care Products, LLC, GN Docket No. 17-183 at 1-2 (Oct. 19, 2017); Reply Comments of Indotraq LLC, GN Docket No. 17-183 at 1-3 (Oct. 19, 2017); Comments of IIDRE SAS, GN Docket No. 17-183 at 1 (Oct. 16, 2017); Comments of Decawave, GN Docket No. 17-183 at 1-3 (Oct. 2, 2017); Comments of IEEE 802, GN Docket No. 17-183, at unnumbered page 7 (Oct. 2, 2017).

<sup>8</sup> Revision of Part 15 of the Commission’s Rules Regarding Ultra-Wideband Transmission, *First Report and Order*, 17 FCC Rcd 7435, ¶ 5 (2002).



various portions of the 3.1-10.6 GHz band, it is highly unlikely they could continue to operate successfully in the presence of newly introduced licensed or unlicensed mobile services.

In raising this concern, Boeing acknowledges that UWB technologies are secondary to services operating under a primary allocation. Nevertheless, the Commission has historically ensured that secondary services are not endangered by harmful interference resulting from the introduction of new services in the same frequency band. For example, in 1985, the Commission authorized unlicensed spread spectrum systems in the 902-928 MHz band.<sup>9</sup> A decade later, the Commission introduced a new licensed primary service in the 902-928 MHz band, the Location and Monitoring Service (“LMS”).<sup>10</sup> In doing so, the Commission recognized the potential for interference to unlicensed devices and adopted a number of technical and operational measures to ensure that licensed LMS systems and Part 15 devices “will be able to achieve their objectives without impeding each other’s use of the spectrum.”<sup>11</sup> The following year, the Commission reaffirmed its decision, explaining “it sought to ensure that LMS systems are not operated in such a manner as to degrade, obstruct, or interrupt Part 15 devices to such an extent that Part 15 operations will be negatively affected.”<sup>12</sup> In this way, the

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<sup>9</sup> See Authorization of Spread Spectrum and Other Wideband Emissions Not Presently Provided for in the FCC Rules and Regulations, Gen Docket No. 81-413, 101 FCC 2d 419 (1985); see also Revision of Part 15 of the Rules Regarding the Operation of Radio Frequency Devices Without an Individual License, GEN. Docket No. 87-389, *First Report and Order*, 4 FCC Rcd 3493 (1989) (also authorizing non-spread spectrum Part 15 devices in the 902-928 MHz band).

<sup>10</sup> See generally Amendment of Part 90 of the Commission’s Rules to Adopt Regulations for Automatic Vehicular Monitoring Systems, *Report and Order*, 10 FCC Rcd 4695, ¶ 1 (1995).

<sup>11</sup> *Id.*

<sup>12</sup> Amendment of Part 90 of the Commission’s Rules to Adopt Regulations for Automatic Vehicular Monitoring Systems, *Order on Reconsideration*, 11 FCC Rcd 16905, 16911-12, ¶ 15 (1996).

Commission has concluded that it is in the public interest to preserve the ability of existing secondary services to continue to operate successfully in the presence of new primary services.

The Commission should exercise this same caution with respect to ensuring that important UWB technologies remain capable of operating successfully throughout the 3.1-10.6 GHz bands without experiencing excessive interference from newly introduced licensed or unlicensed mobile communications services. The Commission's decision to permit the operation of UWB services has been tremendously successful, facilitating the development and commercial use of countless innovative products and services that benefit manufacturers, businesses and consumers. The Commission should ensure that any action that it takes to introduce new services in the 3.7-4.2 GHz and 5.925-7.125 GHz bands adequately facilitates the continued growth and use of UWB technologies in these frequency bands in furtherance of the public interest.

### **III. THE COMMISSION MUST ENSURE THE PROTECTION OF RADIO ALTIMETER AND AERONAUTICAL WAIC SYSTEMS IN THE 4.2-4.4 GHZ BAND**

As Boeing emphasized in its comments, any consideration of additional use within the 3.7-4.2 GHz band must ensure the ongoing protection of aircraft radio altimeter and wireless avionics intra-communications ("WAIC") systems, which operate in the immediately adjacent 4.2-4.4 GHz band. Radio altimeters are an essential component of the safe operation of aircraft, supporting precision approach, landing, ground proximity, and collision avoidance systems.<sup>13</sup> In addition, wireless WAIC systems are increasingly being deployed on new aircraft to increase the

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<sup>13</sup> See Operational and Technical Characteristics and Protection Criteria of Radio Altimeters Utilizing the Band 4 200-4 400 MHz, Recommendation ITU-R M.2059-0, at 1, 3 & 5 (2014).

safety and efficiency of their operations by using onboard short range wireless systems operating in the 4.2-4.4 GHz band to replace a potentially substantial portion of aircraft wiring.<sup>14</sup>

Other parties also expressed concern regarding the need to protect these critical safety-of-life services. For example, ASRI explained that radio altimeters are “one of the main aircraft sensor systems during the critical phases of flight such as landing and takeoff in low/zero visibility weather” and “any and all interference to the radio altimeter, no matter how brief, should be considered a safety of flight issue.”<sup>15</sup> Zodiac Inflight Innovations (“Zodiac”) also recommended that the “FCC proceed with caution to avoid potential interference to existing [radio altimeter] operation and emerging WAIC operations from IMT operation in frequency bands adjacent to the 4.2–4.4 GHz frequency band.”<sup>16</sup> Finally, Aerospace Vehicle Systems Institute explained that the possible introduction of mobile systems in the 3.7-4.2 GHz band was already studied in the ITU process in advance of WRC-15 and was rejected because of conclusions “that the interference characteristics of International Mobile Telecommunications (“IMT”) use of adjacent bands cannot be adequately predicted to ensure continued safe operation of the radio altimeters.”<sup>17</sup>

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<sup>14</sup> See, e.g., Presentation of the Aerospace Vehicle Systems Institute for Working Parties 5A, 5B, 5C, “Agenda Item 1.17 Wireless Avionics Intra-Communication” (May 23, 2012) (available at <https://www.itu.int/ITU-R/study-groups/docs/workshop-wp5abc-wrc15/WP5ABC-WRC15-P2-5.pdf>).

<sup>15</sup> *ASRI Comments* at 4.

<sup>16</sup> See Comments of Zodiac Inflight Innovations, GN Docket No. 17-183, at 1 (Oct. 2, 2017) (“*Zodiac Comments*”).

<sup>17</sup> Comments of Aerospace Vehicle Systems Institute, GN Docket No. 17-183, at 1 (Oct. 2, 2017).

Given the widespread agreement on the importance of these safety-of-life services, the Commission should avoid authorizing any new mobile services in the upper portion of the 3.7-4.2 GHz band where they could result in harmful interference to radio altimeter and WAIC operations on aircraft.

#### **IV. THE COMMISSION SHOULD PROCEED WITH CAUTION IN CONSIDERING THE 5.925-6.425 GHZ BAND FOR LICENSED OR UNLICENSED SERVICES**

The NOI seeks comment on the potential use of the 5.925-6.425 GHz band either for licensed or additional unlicensed services. As discussed above, the 5.925-6.425 GHz bands support the uplink transmissions for critical satellite communications services and therefore any additional use proposed for these frequency bands must be restricted to ensure protection of incumbent satellite services.

One party, Zodiac, argued in its comments that the 5.925-6.425 GHz band should be made available for unlicensed services in order to increase the amount of unlicensed spectrum that is available for use inside airplanes.<sup>18</sup> Zodiac claims that additional unlicensed spectrum is needed for use onboard aircraft because the dynamic frequency selection (“DFS”) and transmit power control (“TPC”) rules that are applicable to portions of the existing unlicensed band at 5.03-5.875 GHz make much of the band unavailable for use on aircraft.<sup>19</sup> The Commission adopted DFS and TPC requirements on unlicensed operations in portions of the 5.03-5.875 GHz band to protect weather and terminal operations radar. Zodiac claimed in supplemental comments that, in the presence of radar signals, the DFS function in unlicensed devices on

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<sup>18</sup> See *Zodiac Comments*, at 1-2.

<sup>19</sup> See *id.*

aircraft causes the unlicensed devices to shift away from the DFS restricted channels and stay off of them for thirty minutes thereafter.<sup>20</sup>

Zodiac's position in both its original and supplemental comments is not supported by field tests undertaken by Boeing. Boeing has conducted tests of unlicensed communications systems on aircraft (including aircraft in flight) in the presence of weather radar using all portions of the 5.03-5.875 GHz band, including those portions that are subject to DFS and TPC requirements.<sup>21</sup> The results of those tests indicate that the entire 5.03-5.875 GHz band can be used for unlicensed services onboard aircraft while still protecting weather and terminal radar. This is likely because the significant attenuation provided by the metallic surface of the aircraft isolates unlicensed signals inside the plane and radar signals outside the aircraft.

Therefore, the DFS and TPC restrictions in portions of the 5.03-5.875 GHz band do not limit the use of this spectrum for unlicensed services onboard aircraft. Accordingly, the DFS and TPC restrictions do not provide justification for introducing additional unlicensed use of the 5.925-6.425 GHz bands. Given the importance of ensuring that the 5.925-6.425 GHz bands remain available for incumbent satellite services, the Commission should forego the introduction of unlicensed services in this spectrum.

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<sup>20</sup> See Comments of Zodiac Inflight Innovations, GN Docket No. 17-183, at 1-2 (Oct. 18, 2017) (“*Zodiac Clarifying Comments*”).

<sup>21</sup> 47 CFR § 15.407(h)(2); Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band, *Report and Order*, 18 FCC Rcd 24484, 24497-98, ¶¶ 39-32 (2003) (requiring that U-NII devices use DFS to continually monitor the radio environment for radar's presence and, if the U-NII device determines that a radar signal is present, it must either select another channel to avoid interference with radar, or go into a “sleep mode” if no other channel is available).

**V. THE COMMISSION SHOULD COMPLETE THE ALLOCATION OF THE 4.400-4.940 AND 5.925-6.700 GHZ BANDS TO THE AERONAUTICAL MOBILE TELEMETRY SERVICE**

As the Commission reaffirmed in 2015, there is a “large and growing” need for access to reliable, high-bandwidth aeronautical mobile telemetry (“AMT”) spectrum to support increasingly complex aeronautical test operations.<sup>22</sup> Therefore, Boeing concurs with the comments of the Aerospace and Flight Test Radio Coordinating Council, Inc. (“AFTRCC”) in urging the Commission to complete the allocation of spectrum in the 4.400-4.940 and 5.925-6.700 GHz bands for AMT as a part of ET Docket numbers 12-338 and 15-99.<sup>23</sup> Although the use of the 4.400-4.940 and 5.925-6.700 GHz bands for AMT will require careful coordination and/or technical measures to avoid harmful interference to incumbent users of the bands,<sup>24</sup> Boeing continues to believe that such measures are achievable, and agrees that as a general matter such sharing is feasible.<sup>25</sup>

**VI. CONCLUSION**

Boeing recognizes the Commission’s goal of expanding the use of mid-band spectrum through the introduction of new or modified services in this spectrum. In pursuing this goal,

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<sup>22</sup> Amendment of Parts 1, 2, 15, 74, 78, 87, 90 and 97 of the Commission’s Rules Regarding Implementation of the Final Acts of the World Radiocommunication Conference (Geneva, 2007) (WRC-07), Other Allocation Issues, and Related Rule Updates, Notice of Proposed Rulemaking and Order, ET Docket No. 12-338, Amendment of Parts 2, 15, 80, 90, 97, and 101 of the Commission’s Rules Regarding Implementation of the Final Acts of the World Radiocommunication Conference (Geneva, 2012)(WRC-12), Other Allocation Issues, and Related Rule Updates, ET Docket No. 15-99, Report and Order, Order, and Notice of Proposed Rulemaking, FCC 15-50, ¶ 207 (Apr. 27, 2015) (“*WRC Implementation NPRM*”).

<sup>23</sup> See Letter from William K. Keane, Counsel for AFTRCC, to Ms. Marlene S. Dortch, Secretary, Federal Communications Commission, GN Docket No. 17-183 (Oct. 2, 2017).

<sup>24</sup> See *WRC Implementation NPRM*, ¶ 216.

<sup>25</sup> See *id.*

however, the Commission must ensure that the continued operation of critical incumbent services is not impaired. For example, the 3.7-4.2 GHz and the 5.925-6.425 GHz bands are necessary to support C-band satellite communications services that often cannot be replicated using satellites operating in other frequency bands, or using non-satellite communications technologies.

In addition, large portions of the 3.1-10.6 GHz band are increasingly being used to support highly innovative UWB services that were specifically designed to operate successfully without causing harmful interference to incumbent services. Although UWB technologies are authorized by the Commission on a secondary basis, the Commission should ensure that these important technologies are not disrupted by the introduction of new or modified services that are less capable of sharing spectrum on a complementary basis.

Respectfully submitted,

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