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January 29, 2019

Ms. Marlene S. Dortch
Secretary
Federal Communications Commission
445 12th Street S.W.
Room 2-B450
Washington, DC 20554

Re: Ex Parte Filing
WT Docket No. 10-4

Dear Ms. Dortch:

This is in further reference to the tentative proposal to allow consumer boosters to operate in the band 2345-2360 MHz.

In an ex parte meeting with the staff on November 15, 2018, Aerospace and Flight Test Radio Coordinating Council, Inc. ("AFTRCC") discussed the challenges associated with coordinating consumer booster operations in a band immediately adjacent to a band used for safety-related flight test operations.[1] In response to questions by the staff, this filing provides additional background information on flight test operations in order to supplement AFTRCC's earlier presentations.[2]

Flight testing, also known as aeronautical mobile telemetry, or "AMT," describes a particular use of the mobile service ("MS") for transmission from an aircraft or missile of measurements relating to the functioning of the vehicle. Examples include engine temperature,

[1] See letter filed November 19, 2018, by Jessica B. Lyons, AT&T.

[2] See also Comments filed by AFTRCC on May 16, 2018.

fluid pressure, and control surface strain gauges, among a host of other functions. Besides telemetry data, video transmission is also increasingly used in flight tests.

Flight testing requires real-time data for the protection of the pilot and aircrew, the test aircraft, and chase planes (if they are used in a particular test), as well as people and property on the ground. Aircraft are put through extreme maneuvers which stress the vehicle to its maximum limits. The telemetry also enables ground-based engineers to detect unsafe conditions, warn the pilot of dangerous conditions, and modify or abort the test in a timely fashion. Interference with flight test telemetry means loss of data, which can put the safety of the pilot, the aircraft, and others at significant risk. In the event disaster strikes during a test and the aircraft is lost, the real-time data collected via radio telemetry enables engineers to more quickly determine the cause, and put into effect any necessary design changes.[3]

The 2360-2390 MHz band also enables aerospace manufacturers to achieve material efficiencies in their test programs. Real-time telemetry greatly improves the efficiency with which a flight test program can be conducted in contrast to other data collection methods like on-board recording; aircraft can be cleared for multiple test points during a single flight, instead of having to return to base for data analysis before being allowed to move to the next set of test points.[4] This in turn enhances the global competitiveness of U.S. aerospace companies.

High-gain parabolic antennas are used to gather telemetry signals from distant test vehicles, often at distances exceeding 200 miles. To detect telemetry at these distances, tracking antennas are extremely sensitive, which also renders them vulnerable to interference. Safety-related flight tests are thus conducted in protected radio bands to minimize the chance of interference/interruption to critical safety communications.

The Commission has recognized on repeated occasions that flight test telemetry exists to enhance safety of flight in what is often a high-risk enterprise. Thus, bands used for safety-related flight testing (such as 2360-2390 MHz) are protected by the Commission. For example, in 1989 the Commission determined that the telemetry bands should be classified as "Restricted" and protected from fundamental emissions of unlicensed devices. The agency stressed that the telemetry bands at 1435-1525 and 2360-2390 MHz "*involv[e] safety of life*."[5] Likewise, in 1990 the Commission concluded that secondary use of flight test frequencies for air shows could result in significant harmful interference "impair[ing] the *efficiency and safety of the flight test*

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3 Not all flight testing involves high risk maneuvers. Given the enormous growth in data requirements, other bands can be used for non-safety related data.

4 With missile tests, of course, the only practical means of gathering data is by means of real-time telemetry, such flights being one-way trips.

5 *In the Matter of Revision of Part 15 of the Rules Regarding the Operation of Radio Frequency Devices Without an Individual License*, 4 FCC Rcd 3493, 3502 (1989) (emphasis added).

industry."[6] More recently, the agency adopted "safeguards [applicable to wireless mikes in the L-band] designed to protect AMT."[7]

Against this background, allowance of consumer boosters in 2345-2360 MHz would be contrary to well-established Commission policy for the protection of AMT. This is underscored by Rule 27.73(a) which prescribes that:

> WCS licensees operating base and fixed stations in the 2345-2360 MHz band must, prior to operation of such stations, achieve a mutually satisfactory coordination agreement with the AMT entity(ies) (*i.e.*, FCC licensee(s) and/or Federal operator(s)) for any AMT receiver facility within 45 kilometers or radio line of sight, whichever distance is larger, of the intended WCS base or fixed station location. The coordinator for the assignment of flight test frequencies in the 2360-2390 MHz band, Aerospace and Flight Test Radio Coordination Council (AFTRCC) or successors of AFTRCC, will facilitate a mutually satisfactory coordination agreement between the WCS licensee(s) and AMT entity(ies) for existing AMT receiver sites.

(emphasis added). While WCS licensees are required to enter into coordination agreements with AMT users, reaching agreements with individual booster users – much less mobile booster users -- would be utterly impractical.

Attached hereto is an Engineering Statement by Daniel G. Jablonski, Ph.D. addressing some of the challenges to coordination presented by the proposal. The Statement discusses the complex coordination process in place between AT&T and AFTRCC. This process permits AT&T to operate its wireless networks in 2345 – 2360 MHz without harmful out-of-band emissions to the reception of flight test telemetry by the numerous AMT ground stations in the band 2360 – 2390 MHz. At the same time, working together AFTRCC and AT&T are able to enhance spectrum efficiency. As the Statement observes, "the introduction of signal boosters

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[6] *In the Matter of Petition to Amend Part 87 of the Commission's Rules to Allot VHF Aeronautical Frequencies for the Coordination of Air Show Events*, Order, 5 FCC Rcd 4641, 4642 (1990) (emphasis added).

[7] *In the Matter of Promoting Spectrum Access for Wireless Microphone Operations Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive,* 30 FCC Rcd. 8739, 8780, para. 106 (2015).

into the 2345-2360 MHz band will disrupt fundamentally the successful coordination protocol [applicable here]."[8]

For the reasons stated here, and in its prior submissions, the Commission should determine not to allow consumer boosters in 2345-2360 MHz.

A copy of this ex parte filing is submitted for the Docket.

Respectfully submitted,

/s/ William K. Keane
William K. Keane
Counsel for AFTRCC

cc: Roger Noel
Kathy Harris
Amanda Huetinck
Moslem Sawez

[8] Id. at page 2.

Engineering Analysis

By

Daniel G. Jablonski, Ph.D., for

Aerospace and Flight Test Coordinating Council, Inc. (AFTRCC)

Analysis of Out-of-Band Interference into Flight Test Ground Stations operating in the band 2360 – 2390 MHz from proposed signal booster transmitters operating in the band 2345 – 2360 MHz.

Re: FCC 18-35, WT Docket No. 10-4:

Amendment of Parts 1, 2, 22, 24, 27, 90 and 95 of the Commission's Rules to Improve Wireless Coverage Through the Use of Signal Boosters
SECOND REPORT AND ORDER AND
SECOND FURTHER NOTICE OF PROPOSED RULEMAKING, March 22, 2018

Aeronautical Mobile Telemetry (AMT) operations are conducted in the band 2360 – 2390 MHz. The band 2345 – 2360 MHz is allocated for fixed and mobile use. It is licensed to and used by AT&T for nationwide downlink transmissions from 4G-LTE base stations (eNodeBs) and related distributed antenna systems (DASs).

A sophisticated coordination process is in place between AT&T and AFTRCC. This permits AT&T to operate its wireless networks in 2345 – 2360 MHz without out-of-band emissions[1] causing harmful interference to the reception of flight test telemetry from aircraft by the numerous AMT ground stations operating in the band 2360 – 2390 MHz. AFTRCC conducts these adjacent band coordinations on behalf of both civil and government flight test ranges.

Custom software tools have been created for the coordination process. These tools permit, for every broadband wireless cell-tower sector antenna and for all DAS systems, quantitative consideration of:

- adjacent channel propagation effects, using ITU-R Recommendation P. 452 with high precision terrain models, between broadband emitters and AMT ground station antennas
- clutter effects calculated using measured, high precision clutter data, rather than assumed values

[1] The permitted out of band emissions in place for broadband wireless emissions in 2345 – 2360 MHz are considerably more restrictive than the blanket 43 + 10 log(P) limit that appears to be contemplated for signal boosters operating in this band. A single un-coordinated booster, operating near an AMT ground station antenna, could easily jam the AMT transmissions from a distant (320 km) aircraft in flight.

- the effects of base station antenna down-tilt on a sector-by sector basis nationwide, including cross-border operations
- the effects of OOBE emission filters on a sector-by sector basis

By including these factors in coordination for every sector and cell antenna, it is possible for AT&T to operate at the "interference edge" of each AMT ground station while simultaneously optimizing its broadband systems for both capacity and coverage. This is done on a dynamic basis, so that changes to the network can be made as needed. The process works by taking advantage of the flexibility of the software tools and because of the close communication between AFTRCC, aerospace companies, and government flight test operators. Note that tens of thousands of sector coordinations have already been completed between AFTRCC and AT&T.

The large number of unlicensed antenna/booster combinations and installation options that are available in the marketplace for re-radiating cell tower downlink signals, both indoors and in vehicles, make it impractical to calculate the potential for interference to existing users of the band. What can be said, though, is that the introduction of signal boosters into the 2345 – 2360 MHz band will disrupt fundamentally the successful coordination protocol described above.

Signal boosters will also undermine the ability of AT&T to optimize its own network performance, which already uses DAS systems for fill-in of areas that experience poor reception or require higher capacity. Furthermore, these properly coordinated ancillary network components, which are similar in some respects to signal boosters, do not present two technical problems that are unique to signal boosters:

- Signal boosters receive and transmit at the same frequency, thus making possible, despite proposed safeguards, unconstrained oscillations that could be radiated out of band at significant power levels.
- Transmissions from AMT aircraft operating in the adjacent band near a signal booster could be "boosted" as well, appearing as a multi-path signal that could disrupt the AMT bit-synchronization process, thus causing harmful "self-interference" to AMT systems.

Finally, it should be noted that any improved signal coverage desired in the band 2345 – 2360 MHz can be achieved, with carrier cooperation, using currently available technology deployed under the existing coordination protocol; i.e. there is no need for boosters. Implementation of 5G networks may render unnecessary any need for signal boosters in this band.

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Dated: January 10, 2019