



Roberson and Associates, LLC
Technology and Management Consultants®

July 9, 2018

Ms. Marlene S. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Written *ex parte* presentation in IB Docket No. 11-109; IBFS File Nos. SAT-AMD-20180531-00044 and SAT-AMD-20180531-00045

Dear Ms. Dortch:

I write to provide technical support for Ligado Networks recent Amendment to its License Modification¹. In the attached document we point out that based on the dramatic reduction in transmission power that they have propose in the Amendment, any remaining technical concerns about the deployment of Ligado's proposed terrestrial network should no longer be warranted. Based on significant testing effort conducted by the National Advanced Spectrum and Communications Test Network (NASCTN) and our own test results, no GPS devices should experience harmful interference based on Ligado's deployed system. Further, any lingering concerns, particularly for high precision GPS devices should be eliminated through use of readily available filtered antennas. With this amendment, Roberson and Associates sees no technical reason to delay a speedy approval of this amended license modification request.

Sincerely,

/s/ Dennis A. Roberson

Dennis A. Roberson
President, CEO and Member

¹ Amendment To License Modification Applications, IB Docket No. 11-109, IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091 (filed May 31, 2018) - [https://ecfsapi.fcc.gov/file/1053120688074/Ligado%20License%20Modification%20Cover%20Letter%20and%20Amendment%20\(5-31-2018\).pdf](https://ecfsapi.fcc.gov/file/1053120688074/Ligado%20License%20Modification%20Cover%20Letter%20and%20Amendment%20(5-31-2018).pdf).



Roberson and Associates comments on recent Ligado Amendment to License Modifications

Ligado Networks recently filed an amendment¹ to its license modification applications with the FCC. The license modification applications, as originally filed on December 31, 2015,² had already reduced the maximum transmit power of the company's proposed base stations in the 1526 to 1536 MHz band (the "Lower Downlink Band") from 42 to 32 dBW EIRP, with Ligado agreeing to accept future reductions in base station transmit power based on an FAA analysis of potential impact to certified aviation equipment. In the recent amendment, Ligado proposes to further reduce the transmit power in the Lower Downlink Band from 32 dBW to 9.8 dBW (or 10 Watts, an extremely low transmit power equivalent to the output power of a very dim light bulb) based on a recommendation received from the FAA. This new reduction protects aviation equipment from any possible interference from base stations in the 1526 to 1536 MHz band.

The reduced power proposed in Ligado's amended modification applications also will further protect GPS equipment beyond the certified aviation category. In 2016 Roberson and Associates reported³ the results of an extensive open and repeatable measurement effort where 27 GPS receivers and devices that include embedded GPS receivers (e.g., cellphones) were subjected to simulated LTE base station interference from the 1526 to 1536 MHz band. Except for certain high precision GPS receivers (retesting with filtered antennas removed them as exceptions – see below), all the devices in the report were judged to be not susceptible to LTE interference from

¹ Amendment To License Modification Applications, IB Docket No. 11-109, IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091 (filed May 31, 2018) - [https://ecfsapi.fcc.gov/file/1053120688074/Ligado%20License%20Modification%20Cover%20Letter%20and%20Amendment%20\(5-31-2018\).pdf](https://ecfsapi.fcc.gov/file/1053120688074/Ligado%20License%20Modification%20Cover%20Letter%20and%20Amendment%20(5-31-2018).pdf).

² License Modification Applications, IB Docket No. 12-340, IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091 (filed December 31, 2015) - <https://ecfsapi.fcc.gov/file/60001396811.pdf>.

³ Roberson Report - <https://ecfsapi.fcc.gov/file/60002112686.pdf>

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base-stations in the 1526 to 1536 MHz band operating at power levels of 32 dBW in at least 99 % of locations. In February 2017, the government's experts at the National Advanced Spectrum and Communications Test Network (NASCTN)⁴ released a report containing detailed interference measurements on 14 GPS devices using a very disciplined and repeatable test approach. Although the NASCTN report did not make any statements regarding susceptibility to interference, the performance data results reported were similar to those observed in the Roberson testing.

The new 9.8 dBW EIRP power level agreed to by Ligado for its Lower Downlink Band terrestrial base stations is a greater than two orders of magnitude, from 1584 Watts to 10 Watts, or more than 100x reduction in transmit EIRP level. Applying the conclusions from the Roberson testing and analysis that assumed a 32 dBW base station power level to analyze Ligado's new power level results in a new conclusion that the likelihood of Ligado's Lower Downlink Band operations causing harmful interference to any non-high precision GPS devices is extremely rare, with a probability of effectively zero.

Both the Roberson and NASCTN testing showed that high precision GPS receivers can also be made immune to interference by using filtered antennas designed for the wide RF bandwidth requirements of high precision GPS receivers for received interference power levels equal to or greater than the levels expected from a 32 dBW EIRP base-station. The Roberson testing also shows that some of the high precision GPS receivers that would have been susceptible to interference from 32 dBW base-stations would no longer be susceptible at 9.8 dBW even without a replacement filtered antenna.

Roberson and Associates, in their measurement report,⁵ calculated the expected power levels from a 32 dBW LTE base station in the 1526 to 1536 MHz band that a GPS receiver operating

⁴ NASCTN Report - https://www.nist.gov/sites/default/files/documents/2017/05/04/nasctn_-_lte_impacts_on_gps_-_briefing_may_2017.pdf

⁵ Roberson Report Appendix C - <https://ecfsapi.fcc.gov/file/60002112686.pdf>

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at ground level would receive. Measurements from the 2011 Las Vegas testing, extensive Monte Carlo simulations, and extensive drive testing were used in the calculations. For a 32 dBW transmitter using Monte Carlo simulations the aggregate received power level would be less than -23.7 dBm in 99 % of locations. The Roberson analysis used a higher and therefore more conservative value of -20 dBm to indicate the 99th percentile (that is 99% of the locations have power less than -20dBm). Reducing the base-station station power to Ligado's proposed level of 9.8 dBW – a reduction of over 22 dB – would shift the 99th percentile received power level to less than -42 dBm or less than 1/10th of a microwatt. High precision GPS devices with filtered antennas have been shown to co-exist with 32dBW base transmitters, and reducing the base transmitter to 9.8 dBW further reduces the need for additional filtering.

In conclusion, the probability of interference to properly designed GPS devices from base stations in the 1526 to 1536 MHz band with power levels of 9.8 dBW EIRP is effectively zero. Any residual concerns, such as older high-performance GPS receivers can easily add additional protection by installing inexpensive nominal filters to cover any perceived filtering need. We note that the company has reached agreements with the major GPS providers including high precision device manufacturers. This underscores the fact that the modified Ligado plan should have no impact on GPS device performance.