

# COVINGTON

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May 31, 2018

Ms. Marlene H. Dortch  
Secretary  
Federal Communications Commission  
445 12th Street, SW  
Washington, D.C. 20554

**Re: Amendment to License Modification Applications  
IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and  
SAT-MOD-20151231-00091 (the “Modification Applications”)  
IB Docket No. 11-109**

Dear Ms. Dortch:

Concurrently herewith, Ligado Networks LLC (“Ligado”) is filing an amendment to the above-captioned Modification Applications to fulfill the commitment Ligado made therein to protect certified aviation GPS receivers by limiting its power in the 1526-1536 MHz Band (the “Lower Downlink Band”) “as necessary to achieve compatibility with current and any future [Minimum Operational Performance Standards] insofar as they are incorporated into an active Technical Standard Order by the FAA.”<sup>1</sup>

As amended, the Modification Applications would:

- (1) consistent with the Department of Transportation’s analysis in its recently released adjacent band compatibility study, require that Ligado’s ATC base stations operating in the Lower Downlink Band not exceed an EIRP of 9.8 dBW (10 W) with a +/- 45 degree cross-polarized base station antenna (an additional reduction of more than 99.3% from the nominal 32 dBW EIRP maximum set forth in the Modification Applications),<sup>2</sup>

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<sup>1</sup> Modification Applications, Description of Proposed Modification at 7.

<sup>2</sup> See U.S. Department of Transportation, “Global Positioning System (GPS) Adjacent Band Compatibility Assessment,” Final Report, at 118-19, 149, 152-53 (April 2018), *available at* <https://www.transportation.gov/sites/dot.gov/files/docs/subdoc/186/dot-gps-adjacent-band-final-reportapril2018.pdf> (“DOT Report”) (concluding EIRP limit of 9.8 dBW (10 W) at 1531 MHz

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- (2) prohibit any Ligado ATC base station antenna in the Lower Downlink Band from operating at a location less than 250 feet laterally or less than 30 feet below an obstacle clearance surface established by the Federal Aviation Administration (under 14 C.F.R. Part 77 and its implementing orders and decisions), and
- (3) require Ligado to comply with the reporting, notification and monitoring obligations set forth in Exhibit 1 to the amendment.<sup>3</sup>

This amendment thus ensures that Ligado's proposed ATC operations will fully protect certified aviation GPS receivers, including the helicopter use case which the DOT found to be the most restrictive of the certified aviation device applications. The other evidence in the record, including the test results from the National Advanced Spectrum and Communications Test Network study and from the Roberson and Associates testing as well as the co-existence agreements with the GPS device manufacturers, establish that other GPS devices can co-exist with Ligado's proposed operations.

Ligado is also committed to providing specific mitigation measures (including but not limited to upgrading or replacing government devices) to address concerns about potential impact on U.S. Government devices and expects a requirement to this effect.

Mid-band spectrum like the spectrum licensed to Ligado is vital to U.S. leadership in 5G because of its reliability and suitability for high-quality coverage and capacity deployment. If the Modification Applications are approved, Ligado will be uniquely positioned to leverage the potential of this mid-band spectrum by offering next-generation network capabilities. Ligado would concentrate on targeted deployments that deliver focused, highly secure and ultra-reliable communications over custom private networks to specific geographic locations that serve the industrial Internet of Things and the emerging 5G markets, particularly in critical infrastructure industry sectors such as rail, trucking, utilities, public safety, and oil and gas. This customized, ground-based network will include macro and micro sites and thus can effectively and efficiently serve the industrial Internet of Things with the power levels contained in this amendment and the Modification Applications.

Ligado plans to invest up to \$800 million in its satellite and terrestrial network capabilities, which could create at least 8,000 jobs. The amendment filed today assures protection for certified aviation receivers. Ligado's co-existence agreements with major GPS

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will protect certified aviation receivers installed in helicopters operating in accordance with applicable existing MOPS).

<sup>3</sup> Given that the sole effect of this amendment will be *reducing* potential interference to other parties, the amendment is deemed "minor" for procedural purposes. *See* 47 C.F.R. § 25.116.

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manufacturers and thousands of hours of empirical testing assure protection for all other classes of GPS devices.<sup>4</sup> Ligado accordingly urges the Commission to act on the Modification Applications expeditiously, thus unlocking billions of dollars in consumer benefits, generating thousands of American jobs and advancing U.S. leadership in spectrum technology.

Please direct any questions to the undersigned.

Sincerely,

/s/ Gerard J. Waldron

Gerard J. Waldron

Michael Beder

*Counsel to Ligado Networks LLC*

cc: Ron Repasi  
Charles Mathias  
Bob Nelson  
Paul Murray  
Paul Powell

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<sup>4</sup> See, e.g., Letter from Gerard J. Waldron, Counsel to Ligado Networks LLC, to Marlene H. Dortch, FCC Secretary, IB Docket No. 11-109 *et al.* (April 12, 2018).

## AMENDMENT TO LICENSE MODIFICATION APPLICATIONS

Ligado Networks LLC (“Ligado”) hereby files this amendment to the license modification applications pending in IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091 (the “Modification Applications”) to further restrict the EIRP limits for Ligado’s proposed ancillary terrestrial operations in the 1526-1536 MHz band (the “Lower Downlink Band”). These stricter EIRP limits reflect not only the analysis Ligado committed to undertake in the Modification Applications with respect to the protection of certified aviation operations but also the conclusion of the Department of Transportation’s Adjustment Band Compatibility Assessment (the “DOT Report”),<sup>1</sup> which assessed the needs of certified aviation GPS receivers. Based on these analyses, Ligado amends the pending Modification Applications to request that the Commission (1) require that Ligado’s ATC base stations operating in the Lower Downlink Band not exceed an EIRP of 9.8 dBW (10 W) with a +/- 45 degree cross-polarized base station antenna, (2) prohibit any Ligado ATC base station antenna in the Lower Downlink Band from operating at a location less than 250 feet laterally or less than 30 feet below an obstacle clearance surface established by the Federal Aviation Administration (under 14 C.F.R. Part 77 and implementing orders and decisions), and (3) for operations in the Lower Downlink Band, require Ligado to comply with the reporting, notification, and monitoring obligations set forth in Exhibit 1 attached hereto.

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<sup>1</sup> U.S. Department of Transportation, “Global Positioning System (GPS) Adjacent Band Compatibility Assessment,” Final Report, at VI (April 2018), *available at* <https://www.transportation.gov/sites/dot.gov/files/docs/subdoc/186/dot-gps-adjacent-band-final-reportapril2018.pdf>.

In the Modification Applications filed on December 31, 2015, Ligado asked the Commission to (1) modify the EIRP limit for the Lower Downlink Band from 42 dBW to 32 dBW,<sup>2</sup> and (2) add a license condition requiring Ligado to “limit its power as necessary to achieve compatibility with current and any future [Minimum Operational Performance Standards] insofar as they are incorporated into an active Technical Standard Order by the FAA.”<sup>3</sup> Ligado committed to “work with the FAA, the RTCA, and the rest of the aviation community to address any concerns and ensure that its operations are compatible with existing and future standards,” through a process that “would assess aviation-specific use cases and the maximum [Ligado] EIRP that would be consistent with the interference tolerance mask that exists for certified aviation equipment under the RTCA DO-229D and related MOPS, both current and future, that are incorporated into an active Technical Standard Order from the FAA.”<sup>4</sup>

Ligado subsequently spent nearly a year in discussions with the FAA, and as the company explained to Commission staff, the process with the FAA “yielded a detailed, workable approach to ensuring compliance with all applicable FAA standards and the protection of certified aviation GPS devices,” including with respect to helicopter operations.<sup>5</sup> This approach

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<sup>2</sup> See Modification Applications, Description of Proposed Modification at 6. The level of 32 dBW in the Modification Applications reflects agreements that Ligado reached with various GPS manufacturers, in which the manufacturers requested the company operate at 32 dBW in the Lower Downlink Band. See Letter from Gerard J. Waldron, Counsel to Ligado Networks LLC, to Marlene H. Dortch, FCC Secretary, IB Docket No. 11-109 *et al.*, Attachment at § 6 (Dec. 8, 2015) (Deere & Company settlement agreement); Letter from Gerard J. Waldron, Counsel to Ligado Networks LLC, to Marlene H. Dortch, FCC Secretary, IB Docket No. 11-109 *et al.*, Attachment at § 9(a) (Dec. 17, 2015) (Garmin settlement agreement).

<sup>3</sup> Modification Applications, Description of Proposed Modification at 7.

<sup>4</sup> *Id.* at 11.

<sup>5</sup> Letter from Gerard J. Waldron, Counsel to Ligado Networks LLC, to Marlene H. Dortch, FCC Secretary, IB Docket No. 11-109 *et al.*, Attachment at 10-11 (June 5, 2017) (“Ligado June 2017

— which, like the DOT Report, sets the maximum EIRP for a tower at the level that protects certified aviation GPS receivers operating at any point outside a “standoff cylinder” with a 250-foot radius from the subject tower and extending 30 feet above the antenna<sup>6</sup> — was then submitted to the RTCA in September 2016, which provided its comments on the methodology to the FAA in December 2016.<sup>7</sup>

Applying the methodology Ligado developed in consultation with the FAA would result in a maximum EIRP in the Lower Downlink Band of 13 dBW, with a lower EIRP required under certain circumstances depending on the specific attributes of a particular site (such as antenna height and downtilt angle), and inclusive of system-wide limitations (such as additional reductions to account for aggregation).<sup>8</sup> The Department of Transportation’s own analysis, as reflected in the DOT Report, concludes that an EIRP limit of 9.8 dBW (10 W) (cross-polarized) at 1531 MHz will protect certified aviation receivers operating in accordance with applicable MOPS even under “*the most restrictive of the certified aviation scenarios examined.*”<sup>9</sup>

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White Paper”). *See also* Letter from Gerard J. Waldron and Michael Beder, Counsel to Ligado Networks LLC, to Marlene H. Dortch, FCC Secretary, IB Docket No. 11-109 *et al.* (Sept. 8, 2016) (describing Ligado’s proposed protocol for protecting certified aviation receivers based on consultations with the FAA).

<sup>6</sup> Compare Ligado June 2017 White Paper at 25-26 with DOT Report at VI-VII.

<sup>7</sup> Ligado June 2017 White Paper at 11.

<sup>8</sup> See Letter from Gerard J. Waldron, Counsel to Ligado Networks LLC, to Marlene H. Dortch, FCC Secretary, IB Docket No. 11-109, Attachment at 6, 8 (Feb. 20, 2018).

<sup>9</sup> DOT Report at VI, 118-19, 149, 152-53 (emphasis added). The DOT Report’s assessment of certified GPS avionics was led by the FAA, which appropriately based its analysis on the principle that such devices “meet their performance requirements when operating within the RF interference (RFI) environment defined in appropriate FAA Technical Standard Orders (TSOs).” *Id.* at II. The DOT Report’s certified aviation analysis thus is free of a fundamental error that fatally undermines the DOT Report’s assessment of all other GPS devices: its empirically unsupported treatment of a 1 dB decrease in a GPS device’s idiosyncratic and self-reported carrier-to-noise-density ratio (C/N<sub>0</sub>) as a proxy for defining when the device has experienced “harmful interference.” *See id.* at 44-45; Letter from Gerard J. Waldron, Counsel to Ligado Networks LLC, to Marlene H. Dortch, FCC Secretary, IB Docket No. 11-109, at 2-3 (April 12,

Ligado accordingly submits this amendment to reflect the DOT Report's more conservative conclusion with respect to the needs of certified aviation receivers. Therefore, Ligado requests that, as a condition of the license modifications requested in the Modification Applications, the Commission require that Ligado's ATC base stations operating in the Lower Downlink Band not exceed an EIRP of 9.8 dBW (10 W) with a +/- 45 degree cross-polarized base station antenna. Moreover, to ensure this EIRP limit effectively protects aviation operations, Ligado requests that the Commission further condition the requested license modifications by (i) prohibiting Ligado from operating any ATC base station antenna in a location where any portion of the 250-foot standoff cylinder would enter an FAA-defined obstacle clearance surface, and (ii) requiring Ligado to notify the FCC and FAA before commencing Lower Downlink Band transmissions by an ATC base station, to continuously monitor the base station's transmit power, and to promptly address any credible report of interference, all as set forth in further detail in Exhibit 1.

Although as a procedural matter this amendment is "minor" — because its sole effect is to *decrease* the risk of interference to other parties<sup>10</sup> — the incorporation of the DOT Report's EIRP limit in the Lower Downlink Band to address the most restrictive use case represents a profound reduction compared to the operating parameters previously proposed for this band. The Modification Applications, as amended, would reduce the EIRP limit for ATC base stations in the Lower Downlink Band from 42 dBW to 9.8 dBW (10 W) — representing a power

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2018); Ligado June 2017 White Paper at 21-24. Ligado's proposed operations in fact will protect GPS devices' position and timing accuracy while enabling the use of prime mid-band spectrum to generate enormous public benefits.

<sup>10</sup> See 47 C.F.R. § 25.116.

reduction of more than 99.9% (from 15,850 W to 10 W) from the level authorized in 2010,<sup>11</sup> and a reduction of more than 99.3% (from 1,585 W to 10 W) from the 32 dBW EIRP maximum reflected in the Modification Applications. To be clear, this codified 9.8 dBW (10 W) EIRP limit would apply to all Lower Downlink Band ATC base stations nationwide and would thus benefit all GPS receivers.

This amendment ensures that Ligado's proposed ATC operations will fully protect certified aviation GPS receivers, including the helicopter use case which DOT identified as the most restrictive of the certified aviation scenarios examined. Ligado's co-existence agreements with major GPS manufacturers and thousands of hours of empirical testing assure protection for all other classes of GPS devices.<sup>12</sup> An updated version of the Technical Operating Parameters chart submitted with the Modification Applications<sup>13</sup> is attached hereto as Exhibit 2. The sole change to the chart is to revise the "New Limit" in the "Power Limit" column from the originally-requested level of 32 dBW to the amended level of 9.8 dBW (10 W).

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<sup>11</sup> *Skyterra Subsidiary LLC*, Order and Authorization, 25 FCC Rcd 3043, 3058 (IB 2010).

<sup>12</sup> *See, e.g.*, Letter from Gerard J. Waldron, Counsel to Ligado Networks LLC, to Marlene H. Dortch, FCC Secretary, IB Docket No. 11-109 *et al.* (April 12, 2018).

<sup>13</sup> *See* Modification Applications, Description of Proposed Modification at 5.



**Exhibit 1**  
**Reporting, Notification, and Monitoring, and Site Location Conditions for  
Lower Downlink ATC Operations**

*Ex ante* commitments

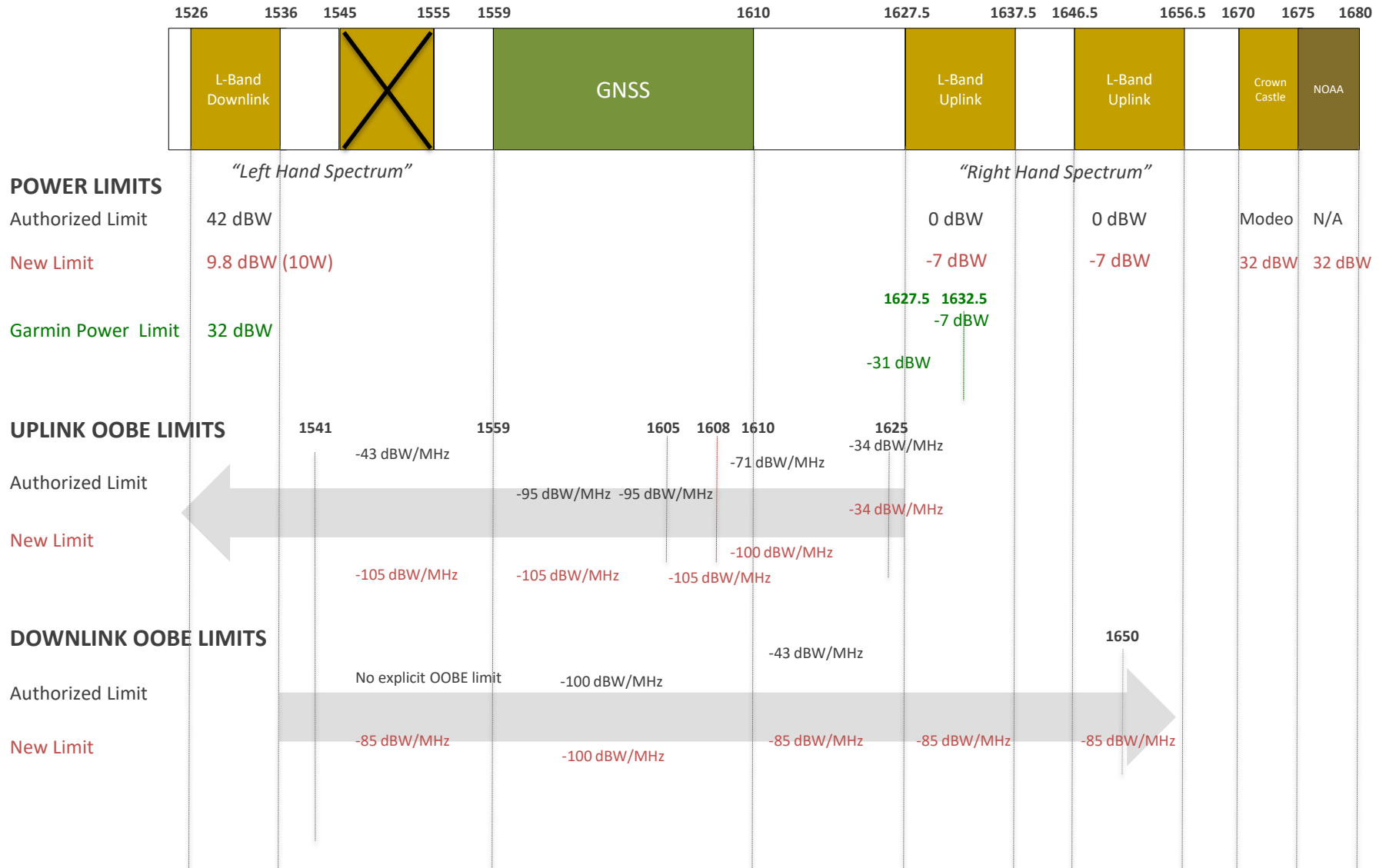
Reporting Requirements	<p>At least 30 days before commencing transmission at a base station site, Ligado to submit to the FCC and FAA:</p> <ul style="list-style-type: none"> <li>• Location of the proposed base station antenna site (latitude and longitude); to be submitted confidentially, access governed by FCC standard rules (e.g. available pursuant to confidentiality order)</li> <li>• Base station antenna radiation center height above ground level</li> <li>• Base station antenna tilt for both mechanical and electrical tilt</li> <li>• Base station antenna specifications, including polarization and pattern</li> </ul>
Additional Tower Placement Restrictions — Protection of Obstacle Clearance Surfaces	<p>To ensure compatibility with 14 C.F.R. Part 77, no tower to be located such that 250' standoff cylinder would pierce the obstacle clearance surface</p>

*Ex post* commitments

Monitoring	<p>Ligado to maintain network operations center procedures for continuous monitoring of the transmit power for each base station site</p>
Responsiveness and Notification Requirements	<ul style="list-style-type: none"> <li>• Ligado to maintain a toll-free telephone number for the public to report relevant apparent incidences of interference from Ligado's operations in the Lower Downlink Band to GPS</li> <li>• If Ligado receives a credible report of interference in the Lower Downlink Band, Ligado to investigate and rectify interfering operations as needed</li> <li>• Ligado to notify the FCC of any such event</li> </ul>

**Exhibit 2**  
**Technical Operating Parameters**

# Technical Operating Parameters Specified in Coexistence Plans



Note: The Coexistence Plans also include narrowband limits not depicted here.