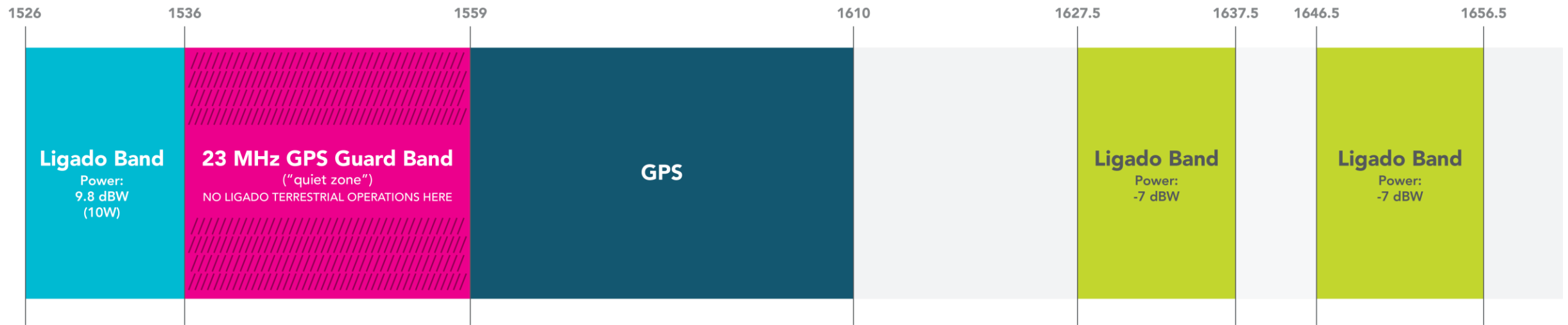


THE FACTS: LIGADO AND GPS

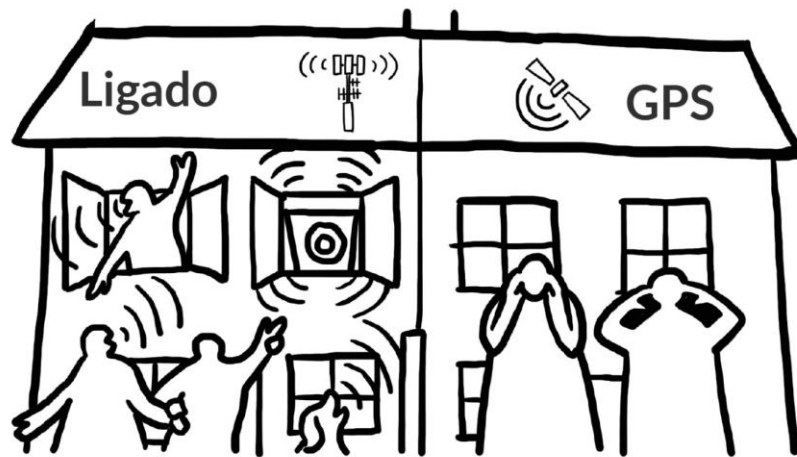
May 2020

Everyone involved in this proceeding—the FCC, Ligado, and the participating executive branch agencies, including the DoD—can agree on the importance and need to protect GPS performance and ensure GPS devices are not impacted in any meaningful way. This means that there is no harmful interference and GPS devices can function without any service degradation.

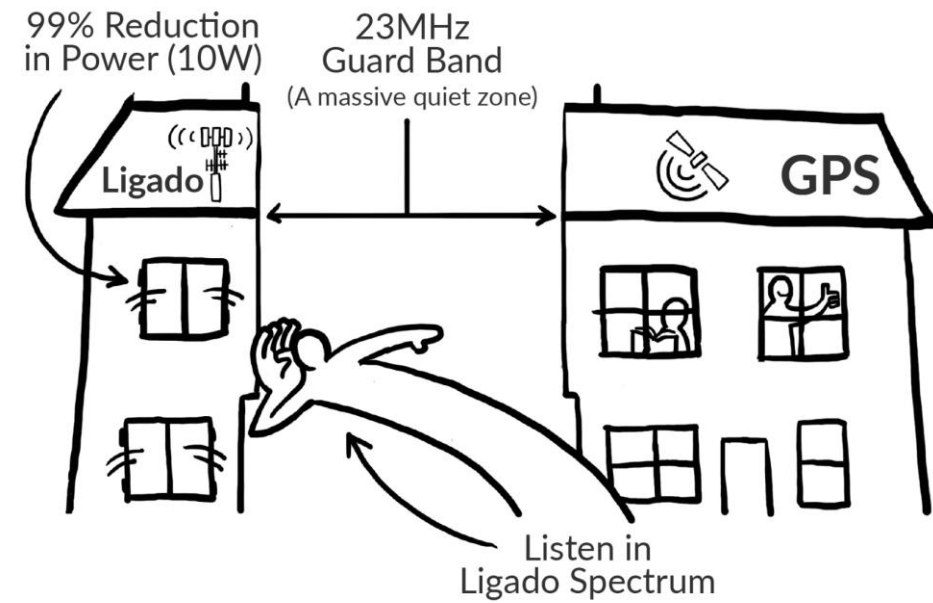
L-BAND SPECTRUM MAP



DOD FICTION



FACTS



as presented in the DOD slide deck to the SASC

Whose Spectrum is It?

The spectrum at issue has been licensed to Ligado since 1989 and authorized for terrestrial use since 2004; This spectrum is not licensed to DOD or any other federal agency or any private GPS stakeholder.

Where Does the License Allow Operations?

Ligado's license, and thus all of its operations, are limited to the U.S.; Ligado will not operate at sea or overseas.

Is This 5G Spectrum?

Yes, just ask Nokia and Ericsson. Not all mid-band spectrum is created equal, and Ligado's lower-mid-band spectrum has key advantages over the 3 GHz spectrum, including superior propagation characteristics that allow for in-building penetration and greater coverage at lower costs, which must not be brushed aside if we are to lead in 5G. This is not an either/or scenario for the U.S.

How Did the FCC Ensure Protection of GPS?

- **Are GPS Receivers Protected in GPS Spectrum?** Yes. For all GPS devices operating in the GPS spectrum (1559 MHz-1610 MHz aka the L1 GPS signal), the FCC Order provides total protection to all GPS devices and users at the 1dB level requested by DoD. DoD also uses spectrum at 1.2 GHz, aka the L2 GPS signal, for mission critical operations.
- **Are GPS Receivers Protected in Ligado's Spectrum?** Yes. For the few GPS devices still operating in spectrum allocated to Ligado (1526-1536 MHz), the FCC Order requires Ligado to lower its power to 10 Watts, the level that the FAA concluded was necessary to protect aviation. Furthermore, the FCC provides significant protections including:

1. providing base station location information and technical operating parameters to federal agencies months in advance of commencing operations in the 1526-1536 MHz band;
2. working with any affected agency to identify devices that could be affected;
3. working with any affected agency to evaluate whether there would be harmful interference from Ligado operations;
4. developing a program to repair or replace any such devices that is consistent with that agency's programmatic needs, as well as applicable statutes and regulations relating to the ability of those agencies to accept this type of support; and
5. in the event that it is determined that Ligado operations will cause harmful interference to a specific, identified GPS receiver operating on a military installation, the FCC expects Ligado and the affected government agency to negotiate an acceptable received power level over the military installation or to establish limited exclusion zones.

Did the FCC Process Provide Opportunity for Input?

The proposal to modify Ligado's license to protect GPS was with the public for over four years, includes hundreds of public comments, and received significant inputs from federal agencies. The FCC circulated the Order to federal agencies over six months ago, and at every request, provided the agencies with additional time for review.

Did DoD Provide any Evidence to Support its Claims about National Security?

No. All information submitted into the process by the DoD, PNT ExCom, and the IRAC agencies was premised on the DOT Study.

What is Needed for GPS to Be Protected?

The establishment of operating parameters for all services that ensure GPS receivers continue to work properly, perform the intended services, and provide accurate information.

Why Did the FCC Reject the DOT Study?

The DOT Study did not study degradation to GPS receivers. It measured fluctuations in the noise level by the tiny margin of 1 dB, and as NASCTN concluded, there is no correlation between when a GPS receiver recognizes a 1 dB change and the performance of that receiver.

What is the NASCTN Study?

[NASCTN](#) is an independent lab set up by DoD and NIST in Boulder, Colorado. The DoD CIO's office in 2016 directed Ligado to use this lab for the study. NASCTN is currently studying other spectrum bands under CRADAs, including AWS and 3 GHz bands. Furthermore, thousands of CRADAs are entered into across government and industry every year. [See Raytheon CRADA with DoD.](#)

What did NASCTN Study?

NASCTN's extensive testing—which consisted of approximately 1,476 hours in the testbed and the collection of over 19,000 data files, subsequently processed to yield a set of 3,859 anonymized data files (780 MB)—studied the location and timing accuracy of GPS devices when exposed to the potential wireless broadband operations proposed by Ligado. Review of NASCTN's results and statistical analyses thus vindicate the judgment of the GPS firms: devices in every category of the GPS ecosystem would not experience actual harm if Ligado were permitted to deploy a terrestrial network in accordance with the proposed parameters. Indeed, the data reveal that GPS devices are highly resilient equipment and already co-exist or can easily be made to co-coexist with the network proposed by Ligado.

FUNDAMENTAL ISSUE 1: WHAT IS HARMFUL INTERFERENCE?

Since the introduction of the Communications Act in 1934, the FCC has always evaluated out-of-band harmful interference based on service degradation, not noise, period. That's exactly what they did in this case. This metric has been used successfully for 85 years and has guided and resolved harmful interference disputes resulting in the success of the U.S. wireless ecosystem. To suggest the FCC – with its 5-0 bipartisan vote – somehow got it wrong or should change this now with zero evidence makes no sense from any standpoint.

FCC

Harmful
interference

=

GPS device
degradation

The FCC Order takes the position that harm means device performance is degraded.

Under the FCC's rules, "harmful interference" is "[i]nterference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service."

DOD

1dB fluctuations in
background noise

≠

GPS device
degradation

The DOD, PNT EXCOM, and the DOT Study define harm not as when a GPS device has performance degradation, but rather, when a miniscule increase in noise — *i.e.*, a 1 dB C/N₀ change — is picked up by the receiver.

FUNDAMENTAL ISSUE 2: IS GPS PROTECTED?

All stakeholders that continue to claim the FCC Order puts GPS receivers at risk and every use case that they cite, are using the DOT Study which is premised on 1 dB C/No.

The disagreement is about whether GPS is entitled to protection outside its allocated spectrum.

FCC

The FCC takes the position that GPS is not entitled to any more protection more than necessary to prevent a degradation in performance. To prevent that degradation, the FCC imposed numerous conditions on Ligado, including:

1. very low power levels;
2. very spaced out towers;
3. very stringent advance deployment notification and coordination requirements;
4. a requirement to repair and replace U.S. Government devices;
5. the potential to establish exclusion zones for military installations as needed.

DOD

DOD / PNT EXCOM takes the position that GPS is entitled to protection far outside of its allocation. But 1 dB does not ensure protection of GPS since it correlates only to fluctuations in background noise rather than actual GPS device degradation. Complying with the President's EO will protect GPS.

EXAMPLES OF HOW DOD PRESENTATION MISCHARACTERIZES ELEMENTAL FACTS

FICTION

Page 5 of the Staff Memorandum to SASC Members and MLAs:

Proposed mitigations put the burden on the DoD and do not provide adequate relief to non-government users; and

FACT

The FCC's order is clear that the burden for replacing any impacted government devices is primarily on Ligado:

Federal Communications Commission

FCC 20-48

105. Finally, we address several of the remaining assertions in the Air Force memorandum. First, we disagree that granting Ligado's 2018 license modification applications would shift the burden onto U.S. governmental agencies to monitor and report interference issues.³⁵⁶ We are conditioning our approval of Ligado's ATC authority on Ligado's commitment to maintain network operations center procedures for 24/7 continuous monitoring of the transmit power for each of its base station sites. This, combined with the information-sharing and negotiation requirements we adopt here, places the burden primarily on Ligado, and not the affected government agencies. Second, to the extent the Air Force is concerned with potential effects to GPS receivers used in support of aviation services,³⁵⁷ the conditions we adopt in this order related to requirements for certified aviation GPS receivers and availability of

Slide 10 of the DOD Presentation to the Committee states:

Ligado's proposal does not include limits on base station spacing; earlier they had suggested a minimum spacing of 400 m

The FCC order is explicit in intersite distance requirement:

Federal Communications Commission

FCC 20-48

2. Power Levels and Operating Restrictions

134. *Downlink Power Level.* Consistent with the DOT ABC Report and Ligado's May 31, 2018 amendment (in fulfillment of its December 2015 commitment to abide by the recommendation of the FAA), Ligado's ATC base stations operating in the 1526-1536 MHz band shall not exceed an EIRP of 9.8 dBW (10 W) with a +/- 45 degree cross-polarized base station antenna. Based on FAA analysis, the minimum inter-station separation distance shall be 433 meters in a hexagonal grid.

NON-FEDERAL SPECTRUM

FCC—INDEPENDENT AGENCY

AS AUTHORIZED BY CONGRESS 47 USC [301](#), [303](#)

STATE + LOCAL GOVERNMENT
COMMERCIAL INDUSTRY
CIVIL USE

FEDERAL SPECTRUM

U.S. PRESIDENT

AS AUTHORIZED BY CONGRESS 47 USC [305](#)

COMMERCE
NTIA
IRAC

AS AUTHORIZED BY CONGRESS 47 USC [902](#), [903](#), [904](#)

ALL OTHER
EXECUTIVE BRANCH AGENCIES