Feb 14, 2020

MEMORANDUM FOR IRAC CHAIRMAN
National Telecommunications and Information Administration
U.S. Department of Commerce
1401 Constitution Avenue, NW
Washington, DC 20230

The Air Force, in the exercise of the Department of Defense's (DoD) statutory duties under 10 U.S.C. §2281, and as the Executive Agent for the Global Positioning System (GPS), and in its role as a member of the National Telecommunication Information Administration (NTIA) Interdepartment Radio Advisory Committee (IRAC), hereby submits supplemental information in support of the Department of Commerce National Telecommunications and Information Administration's letter to Federal Communications Commission (FCC) Chairman Ajit Pai of December 6, 2019. Specifically, this letter provides additional detail regarding the expected impacts on national security, operational impacts to the warfighter, and effects on the military potential of GPS by the proposed license modification sought by Ligado Networks (Ligado).

Extensive and technically rigorous testing and analysis conducted over the past nine years by DoD, the National Space-based Positioning, Navigation and Timing Systems Engineering Forum (NPEF), the Department and Transportation (DOT), and the Air Force[1] has shown – and Ligado itself has conceded – that the proposed Ligado (previously LightSquared) license modification threatens disruption of the GPS, which is a critical National Security System. As such, the Secretary of Defense, pursuant to 10 U.S.C. §2281, "may not agree to any restriction on the GPS System proposed by the head of a department or agency of the United States outside DoD that would adversely affect the military potential of GPS." It is DoD's position that FCC approval of Ligado's license modification would cause unacceptable operational impacts to the warfighter and adversely affect the military potential of GPS by negatively impacting GPS receivers. Ligado's proposed accommodations of identifying and then repairing or replacing potentially-impacted legacy equipment is not feasible, affordable or technically executable given the vast number of systems implicated, including critical national security and weapon systems. Accordingly, DoD remains strongly opposed to granting the license modification sought by Ligado.

On December 6, 2019, the Acting Deputy Assistant Secretary of Commerce for Communications and Information and the Administrator of the NTIA sent a letter to the Chairman of the FCC indicating the executive branch could not support approval of the license modification request of

[1] The Air Force conducted GPS receiver testing at White Sands Missile Range (WSMR) in April 2016. These tests, the results of which are classified, supported the conclusions drawn from the DOT testing at WSMR conducted during the same month.

Ligado. This decision was supported by recommendations by the National Space-based Positioning, Navigation, and Timing Executive Committee (PNT EXCOM) and by the June and November 2019 letters from the Secretary of Defense expressing strong opposition to the Ligado license modification request.

DoD is providing this supplemental information in support of the NTIA letter with specific focus on expected national security and defense impacts to GPS, including operational impacts to the warfighter, if the proposed license modification request were granted.

The Department is providing the following specific information in three categories: 1) national defense mission categories that would be negatively impacted; 2) cost and resource implications of identifying and repairing or replacing any potentially adversely affected GPS receivers supporting national defense missions; and 3) the time, disruption, and programmatic impact to identify and repair or replace the potentially affected GPS receivers supporting national defense missions. Individually and collectively, each of these categories would adversely affect the national defense and security of the United States. It is the Department's position that there are no practical measures to meaningfully mitigate the impact of the proposed Ligado license modification.

The mitigation measures Ligado has proposed are impractical and un-executable in that they would shift the risk of interference to, and place enormous burdens on, agencies and other GPS users to monitor and report the interference. Moreover, Ligado's mitigation proposals would not protect the vast majority of GPS receivers, such as airborne uses, that are not restricted to specific defined areas of operation such as military installations. Ligado's proposal to replace government GPS receivers that are affected by its proposed network,[2] is a tacit admission that there would be interference, and is further addressed below in terms of cost, operational and mission impact, and timelines to replace these receivers. Additionally, the mitigation proposal by Ligado, even if technically feasible, only covers those receivers owned by the government and would leave many high-value federal uses of civil GPS receivers not owned by the government, such as high precision receivers,[3] vulnerable to interference, as Ligado has admitted in its filings.

Expected Operational and Mission Impacts

The U.S. National Security Strategy emphasizes the importance of maintaining leadership and freedom of action in space as a vital U.S. interest as well as responding to any interference to the

[2] *See, e.g.*, Letter from G. Waldron, Counsel to Ligado, Amendment to [FCC] License Modification Applications, IBFS File Nos. SES-MOD-20151231-00981, etc., IB Docket No. 11-109, at 2 (May 31, 2018).
[3] *See, e.g.*, Ligado Notice of Ex Parte Presentation in IB Docket No. 11-109, (Nov. 21, 2019); Ligado Notice of Ex Parte Presentation in IB Docket No. 11-109 (Aug. 6, 2019).

Department's critical space capabilities.[4] The National Defense Strategy stresses the importance of building a more lethal force and strengthening (interoperable) alliances and partnerships.[5] GPS is one such space capability critical to the lethality of the Department's forces and around which, over the years, the Department has structured its weapons systems and business processes. GPS is widely and heavily integrated throughout DoD in operations and applications including, but not limited to, precision weapons, air, land, and sea navigation, communications and network synchronization, command and control, civil engineering, and surveillance applications. Given the sophistication, classification, and the nature of how GPS receivers are embedded into all aspects of DoD testing, training, exercise and operations, it would be practically impossible for DoD to identify and repair or replace all of the potentially adversely affected receivers. These are not simple "plug-n-play" devices but would require significant time and resources to effect software modifications, trial and testing, and validation. The Department simply cannot accept such negative operational and mission impacts to our warfighting capabilities. In addition, military GPS receivers are also used by Federal civil agencies, specifically the National Aeronautics and Space Administration (NASA), the Department of Homeland Security (DHS), and the Department of State through agreements with the DoD. For example, NASA uses high-precision military GPS receivers for their launch anomaly monitoring and destruct systems. DHS and the border patrol use military GPS receivers in unmanned aerial surveillance systems (UAS). In addition, some law enforcement and intelligence agencies use military GPS in their UAS. The State Department's diplomatic security service also uses military GPS receivers. It would be untenable for the United States to pursue an initiative that undermines these capabilities, and it would be exceptionally detrimental to national security.

Ligado's proposal would have significant effect on legacy military receivers and civil receivers used by DoD.

Legacy Military GPS Receivers: Modernized GPS receivers cannot replace all military GPS receivers currently in use. Even after the transition to modernized military receivers is completed (by 2035 at the earliest), some high precision receivers would remain vulnerable to interference from the Ligado network transmissions. Remaining legacy military receivers are unable to lock onto weak signals and lack the anti-jam capabilities more typical of more modern military receivers. In addition to continued military use, other Federal agencies and many partner nations will continue to use these legacy high precision receivers. Even as the U.S. military transitions to modernized GPS receivers, it is unclear as to when, or if, legacy GPS high precision receivers used by other critical agencies will be modernized.

Civil GPS Receivers Used by DoD: DoD makes use of civil GPS receivers in non-combat environments, such as surveying, flight training, training, exercises, other national security

[4] National Security Strategy of the United States of America, December 2017
[5] Summary of the National Defense Strategy of the United States, 2018

events, and scientific applications. Like their civilian counterparts, DoD surveyors and construction units often rely on high-precision GPS receivers that are exceedingly sensitive to interference from signals at nearby frequencies. As analysis indicates, these high precision GPS receivers potentially could be adversely affected at significant distances from the Ligado-proposed terrestrial transmitters, which would negatively impact high precision receiver use in major military installations near urban areas of the United States. Ligado has admitted in its filings that there would be such interference. Additionally, both civilian and commercial applications for high precision wideband-GPS provide far-reaching benefits to the public interest, including capabilities that go beyond the PNT services for which it was originally developed. The great potential capabilities wideband GPS applications hold would also be the most susceptible to the adjacent band interference from Ligado's proposed network. Further, DoD uses civil and commercial infrastructure of many types on bases and test/training ranges domestically and abroad. To the extent that operation of commercial infrastructure is degraded by Ligado's proposed signals, DoD's use of electrical power, communications networks, operation of unmanned vehicles (including UAS), precision landings, helicopter operations, collection of location based services data, first responder applications, and other applications demanding high accuracy would be at increased risk.

Cost and Resource Impacts

By 2024, DoD will have invested more than $15 billion taxpayer dollars since 2000 to sustain and modernize the GPS constellation and continue to modernize GPS user equipment integration across the force. As described earlier, almost every GPS receiver fielded throughout the DoD joint force potentially could be adversely affected if Ligado's proposal is approved. As indicated in the Fiscal Year 2020 President's Budget, DoD is currently planning to spend more than $1.8 billion taxpayer dollars to procure, integrate and test modernized GPS receivers, from 2019-2024, into user platforms across the Services. The $1.8 billion figure will grow to a total of approximately $3.5 billion when all of the approximately 1 million GPS receivers currently in the DoD inventory are transitioned to modernized GPS receivers before 2035. This cost includes the integration of the receivers into each of thousands of different air, maritime, and ground vehicles, as well as weapons.

Regarding Ligado's proposal to identify and repair or replace potentially affected GPS receivers owned by the U.S. government, given the classified nature of the military use and the sheer number of platforms potentially affected, Ligado could not possibly know the magnitude of the problem or the costs and operational impacts relative to military receivers. To avoid an adverse effect to the Department's capabilities if Ligado's proposal were approved, DoD would need to undertake unprecedented accelerated testing, modification, and integration actions, which is cost- and schedule-prohibitive and would likely result in significantly degraded national security. For each integration, DoD would need to take the asset out of service, test the platform to ensure that the upgrade worked as planned and did not cause a negative impact to other parts of the weapons system prior to re-fielding. To be clear, every weapons system or platform in the DoD inventory

must be tested as an integrated system and it would cause significant operational impact (including substantial retesting) if modernized military GPS receivers require further modification. Adding such a requirement to mitigate the adverse effect to the military potential of GPS from this potential interference would be extremely difficult and likely cost prohibitive given current technology.

Time Required to Replace Impacted Receivers

Modification or replacement of GPS receivers within DoD has historically taken approximately a decade due to the sheer receiver numbers, complications with how receivers are integrated in thousands of platforms and systems, depot and scheduling, and global operations. The first M-code capable receivers are now going through integration and testing and will begin installation in DoD platforms beginning in 2020. The full transition is not expected to be complete until at least 2035, based on past experience transitioning from first and second-generation GPS equipment to the present third generation. Any change to the requirements for these modernized receivers as a result of approving Ligado's proposed network and the need to mitigate the resultant interference would only extend that timeline, putting DoD forces and warfighting capabilities at risk due to the rapidly evolving threats.

It is therefore DoD's position that approval of Ligado's proposal would adversely affect the military potential of GPS significantly, based on the extensive testing done by DoD and others. Consistent with 10 U.S.C. §2281, DoD cannot accept this adverse impact to military use of GPS and the resultant negative operational impacts to our warfighting capabilities. Modification or replacement of GPS receivers across the force to avoid adverse impacts from such a proposal, even if a solution were shown to be feasible, could take on the order of billions of dollars and delay fielding of modified equipment needed to respond to rapidly evolving threats by decades.

In his June 7, 2019 letter to FCC Chairman Pai, Acting Secretary of Defense Shanahan stated there are too many unknowns and the risks are far too great to federal operations to allow Ligado's proposed system to proceed. We collectively agree with that assessment. Accordingly, the Department of Defense, pursuant to its statutory duties, restates its formal objection to Ligado's request for a license modification and, along with the below signatories, requests that it be rejected.

LUU.THU.ANH.1268853266 Digitally signed by LUU.THU.ANH.1268853266 Date: 2020.02.14 15:55:41 -05'00'

Ms. Thu Luu
Department of the Air Force
Executive Agent for GPS

The undersigned IRAC agencies endorse and support the position stated by the Department of the Air Force and the Department of Defense:

BAUER.SARAH.CORTEVILLE.1094471717 Digitally signed by BAUER.SARAH.CORTEVILLE.1094471717 Date: 2020.02.19 08:34:33 -05'00'

Ms. Sarah Bauer
Department of the Army

WILLIS.KENNETH.RICHARD.JR.1041234985 Digitally signed by WILLIS.KENNETH.RICHARD.JR.1041234985 Date: 2020.02.19 09:52:24 -05'00'

Mr. Kenneth Willis
Department of the Navy

Digitally signed by NAVARRO.IVAN.RODRIGO.1365825005 Date: 2020.02.19 13:13:26 -05'00'

Mr. Ivan Navarro
Department of Commerce

RENE BALANGA Digitally signed by RENE BALANGA Date: 2020.02.19 09:15:26 -05'00'

Mr. Rene (RJ) Balanga
NASA

RAMON GLADDEN Digitally signed by RAMON GLADDEN Date: 2020.02.19 12:32:41 -05'00'

Mr. Ramon L. Gladden
Department of the Interior

QUAN VU Digitally signed by QUAN VU Date: 2020.02.19 14:09:38 -05'00'

Mr. Quan Vu
Department of Justice

JOHN J CORNICELLI Digitally signed by JOHN J CORNICELLI Date: 2020.02.19 07:15:34 -05'00'

Mr. John Cornicelli
Department of Homeland Security

BRADFORD BENBOW Digitally signed by BRADFORD BENBOW Date: 2020.02.19 13:54:59 -05'00'

Mr. George Dudley
Department of Energy

Jonathan Williams Digitally signed by Jonathan Williams Date: 2020.02.18 11:19:15 -05'00'

Mr. Jonathan Williams
National Science Foundation

James A Arnold

Mr. James Arnold
Department of Transportation

ULCEK.JERRY.L.1521707280 Digitally signed by ULCEK.JERRY.L.1521707280 Date: 2020.02.19 13:01:49 -05'00'

Mr. Jerry Ulcek
U.S. Coast Guard

Michael L Richmond

Mr. Michael Richmond
Federal Aviation Administration