National Aeronautics and Space Administration
Headquarters
Washington, DC 20546-0001

Reply to Attn of: Space Operations of Mission Directorate

The Honorable Larry Strickling
Asst Secretary of Commerce
U.S. Department of Commerce
1401 Constitution Avenue, NW
Washington DC 20230

July 20, 2011

Dear Mr. Strickling:

In response to Federal Communications Commission (FCC) Public Notice DA 11-1133, the National Aeronautics and Space Administration (NASA) is pleased to provide the attached comments on the LightSquared and United States Global Positioning System (GPS) Industry Council co-chaired Technical Working Group Report (TWG), and LightSquared's Recommendations, submitted to the FCC on June 30, 2011.
As you are aware, NASA has extensive use of the GPS for positioning, navigation, and timing, as well as many science applications. NASA would like to highlight its use, as well as other federal and commercial users, of high precision receivers. We have seen no evidence that these receivers can be filtered without significantly reducing receiver accuracy and performance, which may render the receivers incapable of performing the science and commercial missions for which they were designed. In addition, LightSquared, in its Recommendations, suggested possible filtering for the TriG receiver. This was not examined in the TWG and, since this receiver will use the signals of multiple Global Navigation Satellite Systems (GNSS) constellations, filtering may not be possible without negatively affecting receiver performance and mission objectives.

NASA is very concerned with LightSquared's Recommendations, as it also articulates a partial solution, use of just the lower 10-MHz on a temporary basis, to its need for deployment of a robust high-density terrestrial network. LightSquared has indicated, in meetings with Federal agencies and filings in this proceeding, that the upper 10-MHz is needed to provide a viable 4G LTE service.

NASA requests that the National Telecommunications and Information Administration (NTIA) solicit the FCC on LightSquared's intended use of the exclusive lower-10 MHz, and its adequacy for a competitive wireless service. NASA feels that due to the severity of the operational impacts, to both government and commercial users, it is conclusive that LightSquared's implementation on the upper 10-MHz is not feasible in the near or long-term.

NASA would be willing to support additional testing and analysis on the lower 10 MHz proposal, if requested by the NTIA as part of a comprehensive study, and assuming the FCC

has responded to NTIA's satisfaction, that there is a defendable business case on the "low-10." In particular, we believe that further study of the Low 10 option should be predicated on an acceptable end state being appropriately articulated.

Appreciate your continued support on this important issue.

Sincerely,

Badri A. Younes
Deputy Associate Administrator
for Space Communications & Navigation

Enclosure

NASA Response to the June 30 Technical Working Group (TWG) Report and LightSquared's Recommendations

NASA Views on the TWG Report:

Background: NASA participated in and led the work of the Space-based Receiver (SBR) sub-group of the TWG and participated in the work of the High Precision Receiver (HPR) sub-group. Testing was conducted at Jet Propulsion Laboratory JPL for the NASA SBRs and HPRs (two of each type). Analysis of the test results for SBRs and HPRs was done at GRC. NASA worked with LSQ and other TWG members on both test and analysis efforts. It should be noted that none of the testing for SBRs or HPRs could be done at power levels either permitted by FCC rules (42 dBW) or planned for the LightSquared (LSQ) network (32 dBW), and so there may be additional interference effects that have not been discovered through testing.

NASA Comments on the TWG Report for the SBRs: The current generation of SBR (IGOR) and next generation SBR (TriG) both suffered significant degradation from the Phase 1A LSQ channel configuration (two 5 MHz channels) considered in the TWG. LSQ did not disagree with the test and analytical results. At LSQ's request, JPL held informal discussions with a filter manufacturer (Delta Microwave) regarding possible filtering of the SBR front end to mitigate the LSQ interference. Actual filters were not available for testing, but data sheets from the manufacturer were examined and found to present excessive performance degradations to NASA's receivers even if the filters could be built to the data sheet specifications.

NASA Comments on LSQ Low 10 MHz Proposal in the TWG Report: The proposal from LSQ to use just the lower 10 MHz channel configuration (1526-1536 MHz) came very late in the process. Despite this, JPL was able to do some limited testing on the Low 10 proposal with respect to SBRs tested earlier in the TWG process. NASA shared the results with the TWG and LSQ.

Concerns with the TWG Report on SBRs: The use of the Low 10 option as a mitigation technique was not discussed to a great extent in the TWG with regard to SBRs. Because of FACA restrictions, NASA did not negotiate with LSQ on the final language of the Report. Use of the Low 10 option, based on limited testing we did, appeared to benefit the IGOR substantially. However, interference would still significantly impact the TriG even if just the lower 10 MHz channel was used. NASA disagrees with the assertion by LSQ that filtering is possible for the TriG as there is no evidence that we have seen, in the TWG or elsewhere, that filtering of the TriG receiver is possible without significant performance degradation.

Concerns with the TWG Report on HPRs: In general, NASA agrees with the GPS community's assessment that HPRs will be harmfully interfered with by all channel configurations of the LSQ network, including the use of just the Low 10 MHz option. There are no known filtering options available that would mitigate the interference from the LSQ network without significant receiver performance degradation.

NASA Views LightSquared's Recommendations (Low 10 MHz Proposal):

NASA does not agree that the use of the Low 10 MHz channel configuration resolves the interference issue between LSQ and GPS. Among the reasons why we believe the Low 10 proposal is unworkable are:

- High Precision and next-generation Space-based receivers (e.g. multi-GNSS signal receivers) would suffer harmful interference even if only the lower 10 MHz channel were used and there are no known filtering options that would alleviate the interference to an acceptable degree without negatively affecting the performance and accuracy of the receiver[1];
- It is only temporary…LSQ has repeatedly stated they need access to all of the MSS L-band spectrum and, according to discussions LSQ had with Mr. Porcari of DoT, they will need the upper 10 MHz channel in the 2013-2014 time frame to have a viable 4G LTE network;
- The fact that even LSQ agrees that not all GPS operations are protected by the Low 10 option, including NASA's high precision science uses. Pursuit of this option divides the GPS users into winners and losers and puts at particular risk the high precision uses that are among the most beneficial to the Nation in terms of productivity and efficiency gains (e.g., agriculture, construction, weather forecasts, earthquake studies, etc…).

Summary and Recommendation:

Since it is well-established that LSQ intends needs to operate on the upper 10 MHz of the L-band after some interim period, and since it is also well-established that such use of the upper 10 MHz channel will have catastrophic negative results for GPS reception, the use of the Low 10 option is only a step in a known bad direction. NASA believes a possible solution is to

[1] Note that the view from LightSquared that only high precision receivers that receive differential corrections via MSS satellite downlinks are adversely affected by the 10 Low option is not correct. The TWG Report has evidence to the contrary and in fact reception of MSS augmentation signals is just one factor in why high precision receivers have wide front ends. Other factors cited in the TWG report include reception of RNSS signals from multiple GNSS constellations, and all signals generated by those constellations, and, according to the TWG Report, high precision receivers "…normally have wide band front ends designed to capture all satellite signal characteristics, and they rely on measurements of the carrier phase of these signals for the highest accuracy levels". Moreover, preliminary testing conducted at JPL for two representative high precision receivers on the 10 Low option showed that one of the two high precision receivers models NASA uses, for example in the IGS, and that do not receive corrections via MSS networks, will still suffer significant interference.

find alternative spectrum[2], including in spectrum holdings LSQ already has, in which to conduct LSQ's planned terrestrial operations and that high power terrestrial operations should not be permitted in the 1525-1559 MHz band. The extensive testing conducted in the TWG and NPEF has now demonstrated beyond reasonable doubt that even limited use by such high power terrestrial wireless operations can have devastating negative consequences for GPS users.

[2] One band that LSQ has floated in discussions with DoT was using portions of the 1435-1525 MHz band used in the U.S. for Aeronautical Mobile Telemetry (AMT). However, as evidenced by the recent actions at WRC-07 in getting significant additional spectrum for AMT, existing AMT spectrum is heavily crowded and previous studies in the ITU showed that co-coverage, co-frequency operations between even low powered MSS downlinks and AMT are incompatible. FCC has yet to take action on implementing the WRC-07 results.