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October 28, 2011

Via ECFS

Ms. Marlene H. Dortch
Office of the Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C.

Re: LightSquared Subsidiary LLC, Application for Modification of Ancillary Terrestrial Component Authority
IB Docket No. 11-109; IBFS File No. SAT-MOD-20101118-00239

Dear Ms. Dortch:

Please find attached the response of Garmin International, Inc. to the *ex parte* letter filed in the above-referenced docket on September 27, 2011 by LightSquared Subsidiary LLC. In accordance with Section 1.1206 of the Commission's rules, 47 C.F.R. § 1.1206(b)(1), this letter and the attachment are being filed electronically with the Commission.

Please contact me if any questions arise regarding this submission.

Very truly yours,

M. Anne Swanson
Counsel for Garmin International, Inc.

Enclosure

Garmin Response to LightSquared's September 27, 2011 Ex Parte Filing Regarding Its "Power On the Ground" Proposal

1. *Aviation – The LightSquared (Power on the ground) proposal does nothing to address the Aviation interference issues with the lower 10 – it may make things worse.* (Garmin's September 15, 2011 Filing, p. 5)

LightSquared September 27, 2011 Response:

The LightSquared proposal to limit power on the ground is only one element of a comprehensive solution and not designed to address aviation receivers in flight. Instead, LightSquared's power on the ground solution is specifically designed to address mobile and portable GPS receivers operating in the vicinity of cellular antenna points such as towers and rooftop installations. Garmin's claim that limiting power on the ground could make the aviation case worse is unsubstantiated and incorrect. Garmin's speculation that LightSquared would choose to limit its power on the ground by decreasing downtilt is wholly inconsistent with optimal network operation and practice and in any event is impractical for a number of reasons. Further, all operators including LightSquared employ several methods to reduce power, of which downtilt is only one.

Garmin Response:

Garmin agrees with LightSquared that its proposal to limit power on the ground is not designed to address potential interference to aviation receivers in flight. Garmin stands by its claim that limiting power on the ground could make the aviation case worse, despite LightSquared's assertion that this claim is unsubstantiated and incorrect. LightSquared has specifically stated that decreasing antenna downtilt is one means that may be used to reduce power on the ground.[1] LightSquared even repeats this possibility in the last sentence of the quoted text above.

Garmin supports reductions in LightSquared's base station transmit power as they will likely reduce the level of interference experienced by all GPS receivers, including airborne GPS receivers. However, the proposal outlined in LightSquared's September 7, 2011 filing does not specify whether reductions to power on the ground will be made solely by reducing transmit power. Garmin's specific concern is that simply reducing power on the ground by reducing antenna downtilt without modifying the base station transmit power will necessarily

[1] In its Ex Parte filing dated September 7, 2011, LightSquared makes the following statement identifying the modification of antenna downtilt as a means of reducing power on the ground: "LightSquared will take immediate corrective action if it is determined that these power level commitments are exceeded, when measured as per the conditions below; such actions might include reducing power or modifying antenna downtilt." (page 5 of the filing).

increase the power levels seen by airborne receivers. All of the analyses performed by RTCA, Inc. ("RTCA") and the Technical Working Group ("TWG") assumed an antenna downtilt of 2 degrees. Decreasing the downtilt beyond this limit will result in increased power aloft and a higher aggregate interference level for airborne equipment, invalidating the RTCA and TWG analyses.

2. *Power Monitoring Process – LightSquared's power monitoring protocol has serious problems.* (Garmin's September 15, 2011 Filing, pp. 7-9)

   a. *Power monitoring begins at 50 meters from the base of the tower or "closest practical point."* (Garmin's September 15, 2011 Filing, p. 7)

   Many towers are sited such that vehicle traffic can frequently come within 50 meters of the tower and still be in the beam of the transmit antenna. (Garmin's September 15, 2011 Filing, p. 7)

   LightSquared September 27, 2011 Response:

   LightSquared proposes the 50m measurement distance because (a) 50m, being such a short distance, is often the closest practical point of measurement access and (b) it is very unlikely that base station power will exceed the proposed limit at distances of less than 50m and not also exceed the limit at distances 50-500m away (where measurements will be taken) given the pattern of the tower/rooftop antennas.

   Garmin Response:

   There are many locations, such as elevated roadways, where a GPS receiver can be within 50 meters of a cell tower and still be within the main beam of a base station antenna. In such cases, contrary to LightSquared's claims, it is clear that base station powers within 50 meters would be higher than those farther from the base station. Given such common scenarios, power monitoring should always begin at the closest accessible point to the base station, even if that point is closer than 50 meters.

   b. *Up to 5000 measurements will be collected, but no spatial sampling requirements are given.* (Garmin's September 15, 2011 Filing, p. 7)

   LightSquared September 27, 2011 Response:

   The 5,000 measurements are proposed as part of an initial test to identify potential hot spots. To the extent that any areas are identified with power levels in excess of the agreed upon levels, detailed static tests will then be performed on the area with the strongest measured signal. The 5,000 measurements in the drive around test are intended to be taken at the rate of 1 per second, which is a

practical rate for such data logging platforms and was used by both Trimble and LightSquared in their independent data collection efforts last May at the Las Vegas field trials. At the above sampling rate, a collection of 5,000 samples involves about 1.5 hours of driving. This should be sufficient to identify peak power levels within the "hot spots" surrounding each base station. The normative measurements are not the initial tests, but the 10 static tests in the 10m x 10m area. These measurements will have a spatial averaging distance of approximately 1 meter. Such fine resolution is completely practical and addresses pedestrian and vehicular use cases.

Garmin Response:

Garmin does not take issue with the proposed number of measurements or the sampling interval used to collect those measurements. Garmin has serious concerns, however, about the ultimate accuracy of the proposed process because LightSquared's sampling procedure does not explicitly specify that the measurements will be distributed uniformly around the base station. In the absence of such uniformity, it is very probable that measurement crews would miss potential "hot spots".

Regarding the "normative measurements," LightSquared must explain how it can achieve a spatial averaging distance of 1 meter with only 10 measurements distributed across a 100 square meter area (10m x 10m). For an area of 100 square meters, the best case spatial averaging using 10 measurements is one sample every 10 square meters. A square of 10 square meters is 3.16 meters per side, significantly more than one meter.

c. *The samples could all be taken in areas where the power is relatively low due to terrain, building obscuration, etc. Areas with good line of site exposure to the tower (and hence high power) could be ignored.* (Garmin's September 15, 2011 Filing, p. 7)

LightSquared September 27, 2011 Response:

The test plan will focus on primary and secondary routes in the range of 50 to 500 meters from the cell site. LightSquared's drive test methodology will be consistent with existing wireless industry standards and protocols for measuring signal strength. LightSquared takes exception to Garmin's accusation that it would attempt to game the process in order to avoid adhering to the power levels to which it has committed.

An advantage to the process that LightSquared has proposed is that it can be replicated by any interested third party if they should ever believe that LightSquared is not fully meeting its commitment.

Garmin Response:

Because LightSquared has failed to identify the proposed standards and protocols that would apply, Garmin cannot adequately evaluate them but, even so, has serious concerns that these protocols may be more suitable to wireless network planning than interference analysis.

Garmin is not suggesting that LightSquared would intentionally "game the process." Garmin is only citing ways in which the proposed drive protocol is insufficiently defined and may fail to identify hot spots in a base station area. Garmin agrees that a drive protocol, if clearly specified, would allow third parties to replicate LightSquared's results. Nevertheless, the very suggestion that third parties may be required to replicate LightSquared's results demonstrates the weakness of LightSquared's approach.

d. *LightSquared proposes to sample "up to 500m from the base of the tower."*(Garmin's September 15, 2011 Filing. p. 8)

LightSquared September 27, 2011 Response:

Garmin does not explain why it considers this distance to be problematic. LightSquared selected this measure because it is the distance in which the strongest on-the-ground power levels are most likely to be observed. If one were to arbitrarily increase the radius, it would merely increase the drive test and analytical complexity without any resulting change in the utility of the data.

Garmin Response:

So long as the drive test protocol includes uniform spatial sampling to include areas close to the base station, Garmin has no issue with also including measurements taken up to 500m from the base of the tower.

e. The procedure for verifying the point of highest power is extremely vague.(Garmin's September 15, 2011 Filing, p. 9)

LightSquared September 27, 2011 Response:

LightSquared disagrees that the proposed procedure is vague but it is prepared to consider reasonable refinements in the field test procedure.

i. *10 measurements are taken within a 10m by 10m square, then measurements averaged in dBs.* (Garmin's September 15, 2011 Filing, p. 9)

LightSquared September 27, 2011 Response:

The intent here is to find the "local mean" as defined in propagation literature [citation omitted] and not to base a go/no-go decision exclusively on the sporadic peaks of multipath peaks which have coherence distance of a fraction of a wavelength (20 cm) at L-band.

ii. *Averaging dBs is not accurate when there is a large variation in measurement values.* (Garmin's September 15, 2011 Filing, p. 9)

LightSquared September 27, 2011 Response:

The literature [citation omitted] shows that spatial averaging over 20-40 wavelengths or 4 - 8 m is the common practice when trying to measure the local mean (the lognormal fading, also referred to as he [sic] slow fading, component), separated from the fast, Rayleigh fading fluctuations caused by movement or multipath.

Averaging power or dBs is the right way to perform this averaging as the slow fading component is normally distributed about the local mean when the mean value is expressed in dBs.

iii. *The local minimum power in the square could be sampled 10 times to give a false low reading.* (Garmin's September 15, 2011 Filing, p. 9)

LightSquared September 27, 2011 Response:

LightSquared's testing will ensure that the 10 spatial sampling points will be approximately uniformly distributed.

Garmin Response:

Garmin welcomes the few additional details provided by LightSquared, which were not present in its September 7, 2011 ex parte filing. In order to allow an assessment of whether LightSquared's proposal comes anywhere close to constituting a "solution," LightSquared needs to provide the distribution of the 10 spatial sampling points documented in more specific test procedures.

LightSquared has also failed to provide any information or details about base station loading during the initial drive test and the "normative sampling" procedures. Base station EIRP is a function of base station loading, and it is not at all clear from LightSquared's proposal how it will ensure that the EIRP observed

during the tests will be representative of that present during peak loading. Absent such details, the proposal cannot be fully evaluated.

3. <u>Lack of Significant Details</u> – *LightSquared's "Corrective Action" plan is insufficient; adjusting downtilt of transmit antenna changes the entire power environment of coverage area; because of this, other areas may be over the power limit, perhaps in a neighboring cell; adjusting downtilt could significantly change the power aloft, affecting Aviation GPS receivers; reducing base station transmit power is the most effective corrective action* (Garmin's September 15, 2011 Filing, p. 10)

LightSquared September 27, 2011 Response:

Garmin appears to be prejudging the means by which LightSquared will adjust and control power on the ground. In some cases, LightSquared may reduce base station EIRP, especially at sites having a low antenna height.

Garmin Response:

Garmin is not prejudging anything. However, in light of the potential disruption to GPS, any mitigation plan must spell out all relevant details. LightSquared's mitigation plan is extremely deficient in specifying implementation details and provides no substantive analysis of the effects that the proposed mitigations might have on different GPS user constituencies, and, given its skeletal nature, does not allow others to even begin to make a technically meaningful and sufficient review. If LightSquared wants the GPS industry to take its proposal seriously, it simply needs to make sure its plan is more fully formed.

4. <u>GLN Devices</u> – *LightSquared's Lower 10 MHz Proposal Raises Significant Concerns for GLN Devices.* (Garmin's September 15, 2011 Filing, pp. 14-23)

   a. *The Lower 10MHz Proposal Interferes with the Installed User Base of GLN Devices.* (Garmin's September 15, 2011 Filing, p. 16)

LightSquared September 27, 2011 Response:

The TWG tests show only two General Location/Navigation ("GLN") devices experienced a 1dB reduction in C/No at the on-the-ground power levels proposed by LightSquared and neither of those devices suffered apparent performance degradation. Therefore, we believe the proposed limit [sic] are a practical and balanced compatibility solution for legacy devices. If desired, additional immunity can be added to upcoming GLN devices at the discretion of the GPS receiver manufacturers.

Garmin Response:

LightSquared's statement presumes that the devices tested in the TWG process by the GLN sub-team represent a comprehensive sampling of the installed user base. In fact, nothing could be farther from the truth. There were 53 devices nominated for testing in the GLN sub-team. Those 53 devices represent a small sample of GLN devices. Of that small sample, only 29 – an even smaller sample -- were actually tested due to time constraints. Furthermore, only a single sample of each device was measured during the TWG process, and only interference susceptibility tests were performed on use of the lower 10 MHz. Sampling 29 devices for just one test and claiming that it is representative of the effect on a user-base exceeding 100 million is statistically fanciful. The GLN subgroup's TWG report made clear that the devices tested were only a sampling of the installed user base, and they should not be considered a comprehensive sampling of the installed user base (TWG Report at 134).

c. *The TWG tests on Lower 10 MHz were insufficient to prove that harmful interference will not occur.* (Garmin's September 15, 2011 Filing, p. 20)

LightSquared September 27, 2011 Response:

Garmin led the sub-team that designed and supervised the tests, which included testing of operation on the lower 10 MHz . . . .

Garmin Response:

LightSquared introduced the Lower 10 MHz proposal late in the TWG testing process, and only one of seven proposed tests was run on this configuration. If LightSquared had heeded GPS industry reports (prior to the commencement of the TWG process) that the proposed downlink configurations would catastrophically jam GPS, more testing time and resources could have been allocated to the Lower 10 MHz configuration, rather than wasting time and resources testing the original downlink configurations which LightSquared should have known, with reasonable diligence, were flawed.

LightSquared September 27, 2011 Response:

. . . The GLN sub team tested every device for the Lower 10 MHz and the test suite selected the 1 dB change in C/N_0 which Garmin has said should be the only measure of harmful interference. Thus, Garmin has not provided any justification for why it believes this testing was insufficient . . . .

Garmin Response:

LightSquared refuses to acknowledge the insufficiency of the testing. LightSquared cannot prove that no harmful interference exists in the large

population of untested GLN devices by just wishing it to be true. The GLN sub-team was only able to test a small fraction of the devices that exist in the installed GLN base. Additionally, only single samples of each device were tested, so the tests do not capture performance variability that is a normal function of manufacturing tolerances. Finally, the tests were all conducted at room temperature in a benign environment, despite the fact that the selectivity of SAW (Surface Acoustic Wave) filters varies over temperature. All of these shortcoming were deliberated by the TWG, and it was determined that, although it would have been the preferred course, these factors could not be tested due to the extremely tight timeframe imposed by the FCC.

Given the very tight time constraints, the GLN test plan was devised as a way to test a small sample of GPS devices to determine if GPS jamming existed in the presence of the LightSquared signals. It was not designed to be comprehensive testing to prove that jamming definitively does not exist. The National Telecommunications and Information Administration (NTIA) has acknowledged the need for more proof by calling for another round of testing of GLN devices using the Lower 10 MHz downlink configuration[2].

LightSquared September 27, 2011 Response:

. . . Moreover, three months have passed since the conclusion of the tests, time that Garmin could have used to do any further testing that it might have considered useful or necessary.

Garmin Response:

Garmin performed its own very careful testing in January prior to the FCC's issuance of the conditional waiver. The test results showed catastrophic jamming by LightSquared's original proposed deployment of a primary terrestrial wireless service in the MSS band adjacent to frequencies used by GPS. The results of these tests were confirmed by the subsequent TWG testing process. LightSquared would not accept the results of Garmin's earlier testing, so Garmin has strong doubts that LightSquared would accept results of further Garmin testing, especially if the results indicate further interference to the installed base of GLN devices by the Lower 10 MHz configuration.

[2] Letter of Lawrence E. Strickling, Assistant Secretary for Communication and Information, National Telecommunications and Information Administration, to William Lynn, Deputy Secretary U.S. Department of Defense, and John Porcari, Deputy Secretary U.S. Department of Transportation, September 9, 2011.

d. *Developing adequate filtering for the lower 10 MHz will still take years to implement and incorporate into products.* (Garmin's September 15, 2011 Filing, p. 21)

LightSquared September 27, 2011 Response:

Most legacy cellular and GLN filter technologies already reject the Lower 10 MHz even at relatively high LightSquared power levels (well beyond those which would be encountered by any device).

Garmin Response:

LightSquared's statement is incorrect. In the Las Vegas "live sky" testing, interference levels were observed at powers significantly greater than the -30 dBm LightSquared now proposes. LightSquared's attempt to say categorically that "most" technologies already reject signals in the lower 10 MHz "even at relatively high" power levels ignores these concrete results. The claim of "most" clearly cannot be extrapolated from the limited number of devices tested during the TWG process.

LightSquared September 27, 2011 Response:

Manufacturers may choose to undertake further rejection which, if broadly adopted, may add no cost or very little given the intense competition that characterizes the component supply marketplace.

Garmin Response:

This statement wholly ignores concerns over interference to the installed user base. It is impossible to retrofit the fielded GLN user base of more than 100 million devices, including non-certified portable aviation GPS devices, with new filters. These devices are not designed to be modified after manufacture and attempting to do so would render them useless. Manufacturers also cannot begin to develop "solutions" given the constantly changing nature of LightSquared's technical proposals and its refusal to take use of the upper 10 MHz "off the table" in a definitively reliable way.

LightSquared September 27, 2011 Response:

The record contains statements by one major cellular GPS technology supplier, Qualcomm, quoting new BAW [Bulk Acoustic Wave] technologies as viable and may at most add 5¢ to a high volume device bill of materials. In some cases upgrading compatibility margin may involve only a part-for-part substitution that requires little or no other circuit or layout modifications.

Garmin Response:

This statement vastly oversimplifies the issue of electronic circuit component substitution for highly complex and extremely sensitive RF devices such as GPS receivers and shows a complete lack of understanding of the wide variety of designs of GPS front ends among the currently deployed universe of GLN devices. It presumes that there is a wide variety of filters compatible with the Lower 10 MHz available to GPS device designer. Further, it presumes that such filters will be 100% compatible with existing designs and require no further changes to the circuit board. Even if such filters had been designed and were available, which is not the case, it would take many months for GPS equipment manufacturers to qualify the new part in their designs. Attempting to substitute new filters without carefully and thoroughly qualifying the change would produce disastrous results. Multiply the amount of time to make such a substitution to one device by the hundreds of currently shipping devices, compounded by the resource limitation of qualified engineers to do this work and the fact that those engineers are already fully engaged in developing new products, and one begins to understand the long time line associated with any mitigation. Even if GPS devices could be modified, there would be no way to make those modifications to the millions of devices in the installed base.

LightSquared September 27, 2011 Response:

While one must acknowledge the design and production pipeline timeframes as a time factor, such interchangeable component modifications are routinely and widely done so as to avoid sole source suppliers and secure more competitive pricing or performance in consumer electronics.

Garmin Response:

In high volume consumer electronics manufacturing, materials are procured in large quantities with large lead times. It would take many months or even more than a year to use up existing stock (including work in process and stock at the manufacturer) of raw materials before such a switch could be made. Again, discussion of component installation substitution assumes that components that would offer a "solution" have been designed and actually exist – which they do not.

LightSquared September 27, 2011 Response:

Certainly this type of action could also be undertaken if a manufacturer felt that it was necessary in order to improve the performance of a specific product. At least one GPS receiver supplier has told LightSquared that it has engaged its component suppliers and now sees a lead time of only a few months to change production, presumably since it views the improved resilience as a competitive differentiator.

To address improved resilience across a broad range of receiver categories, LightSquared continues to develop the market using its in-house and outside technical resources to advance the art and sharpen awareness of component filter suppliers, all of which benefits Garmin and others. Indeed these are actions that any responsible manufacturer could have undertaken as soon as they learned of LightSquared's plan for a terrestrial network, or at the very least, when LightSquared filed its proposed mitigation plan with the FCC.

Garmin Response:

LightSquared's plans are continually changing with a steady stream of press releases and filings offering various "mitigation plans." It is impossible to engineer a GPS device to be resilient to jamming in an RF spectrum landscape that changes weekly. Moreover, as noted above, use of the Upper 10 MHz of MSS spectrum has never been formally renounced, only put on "standstill". If LightSquared decides in the future to utilize this portion of the MSS spectrum for high powered terrestrial transmissions, any engineering effort directed at divining a "solution" for use of the Lower 10 MHz would be for naught. Good engineering can only occur with a settled spectrum plan and with well defined transmit powers and bandwidths. LightSquared has not set forth a concrete, stable deployment plan that GPS manufacturers could take into account in attempting to design products that might not suffer disabling interference from LightSquared.

e. *The handset issue has not been studied sufficiently.* (Garmin's September 15, 2011 Filing, p. 22)

LightSquared September 27, 2011 Response:

The potential impact of LightSquared user devices was tested and analyzed by the Cellular sub-group. Those tests showed no degradation to cellular devices, which use similar front end pre-selectors as the GLN devices, at less than 1 meter range . . . .

Garmin Response:

There is no evidence that the results from the Cellular sub-team can be extrapolated to GLN devices. There was no correlation between Cellular and GLN devices in terms of stand-alone uplink or downlink tests, so it is curious that LightSquared would propose such an association now. Its logic is faulty. When evaluating GLN devices, what matters are the GLN sub-team test results, not the test results from other sub-teams. GLN devices are very diverse and use a diverse set of RF front end components and GPS demodulators, wholly different from cellular devices.

LightSquared September 27, 2011 Response:

. . . Garmin's claim that tests could not be conducted because LightSquared user devices are not yet in production cannot be given credence; fully satisfactory tests can be performed using instrumentation that simulates uplink LTE signal similar [sic]. Indeed, many of the other TWG sub-teams chose to perform such tests as part of their comprehensive test plans. Garmin provides no credible justification for why the GLN team, which it led and had several employees as members, chose not to do so.

Garmin Response:

In this statement LightSquared once again demonstrates its ignorance of the GLN test plan. In the test plan, detailed handset testing was specified. Yet, due to the extreme time constraints of the TWG process, only one handset test was actually performed. Table 7 from Appendix G.1 of the TWG Report, which is reproduced here, sets forth the proposed test plan for evaluation of LightSquared handsets:[3]

		LightSquared Interference - Uplink			
		Phase 0/1 --> 5 MHz BW [1]		Phase 2 --> 10 MHz BW	
	Test Item	1654.2 MHz	1630.3 MHz	1632.5 MHz	1651.7 MHz
Static Test Cases	Interference Susceptibility Test	No Time	X	No Time	No Time
	Interference Susceptibility Test (Acquisition Sensitivity)	No Time	No Time [2]	No Time	No Time
	TTFF - Cold Start	No Time	No Time [2]	No Time	No Time
	TTFF - Warm Start	No Time	No Time [2]	No Time	No Time
	WAAS Demodulation Test - Cold Start to Differential Fix	No Time	No Time [2]	No Time	No Time
Dynamic Test Cases	Simulated Position and Velocity Tests	No Time	No Time [2]	No Time	No Time
	Naviation Position and Velocity Tests	No Time	No Time [2]	No Time	No Time
	TTFF - Cold Start	No Time	No Time [2]	No Time	No Time
	TTFF - Warm Start	No Time	No Time [2]	No Time	No Time

Table 7: Test Matrix – Uplink Tests

[1] Whereas Lightsquared requested a change to the Phase 0b downlink signal parameters on the afternoon of 5/17/2011, no change was made to the uplink signal parameters.

[2] While the other uplink tests in this matrix had been bypassed prior to testing start due to time limitations imposed on the sub-group, these tests were removed during the first week of testing (5/16/11) as it became apparent that we would not have time to complete them.

[3] TWG Report, Appendix G1 at 10.

Although the TWG acknowledged that other handset tests were needed, the GLN test plan did not discuss such tests.[4]

Because of the lack of time, other factors were not taken into consideration that should be to make a more complete evaluation of the potential for interference from LightSquared. For example, it is highly likely that there will be multiple LightSquared handsets in close proximity to each other once the LightSquared commercial service reaches the goals set forth in its business plan.[5]

Further, since the publication of the TWG report, concerns have been raised about the Out of Band Emission (OOBE) limits from the handset uplink band.[6] The aggregate effect of OOBE emissions from multiple handsets has not been studied as well.

These are very legitimate concerns about potential GPS interference that have not been tested and must be investigated to satisfy the FCC's requirement that LightSquared address all GPS interference concerns before commencing commercial service.

f. *The lower 10 MHz raises concerns for Modernized GPS Signals; GPS signals, which are increasingly being utilized by GLN devices, occupy the entire RNSS spectrum, requiring wideband front end designs. It is not clear that these modernized signals are compatible with the lower 10MHz proposal. Filter design for lower 10MHz (is) much more difficult when the entire RNSS band must be protected.* (Garmin's September 15, 2011 Filing, p. 23)

LightSquared September 27, 2011 Response:

The GPS L1 Modernized signal frequency spectra are shown below for quick reference. Note that the greatest difference in wideband signals at the L1 is the new M code, which will have a main lobe approximately 10 MHz below the L1 center frequency [diagram omitted] . . . .

Garmin Response:

It is interesting that LightSquared mentions the M code in this discussion. The M code is a military-only signal, and will not be available for civilian use. It was designed under the auspices of the US Air Force Joint Program Office by engineers

[4] In the TWG report, the GPS Industry stated: "It should be noted that no LightSquared handsets exist, so no one has been able to verify the actual effects of multiple handsets in close proximity." TWG Report at 142.
[5] January 26, 2011 FCC Order and Authorization, ¶ 6.
[6] Letter from Catherine Wang, Counsel for Deere and Company, to Marlene H. Dortch, Secretary, Federal Communications Commission, IB Docket No. 11-109 and FCC File No. SAT-MOD-20101118-00239 *ex parte* (September 22, 2011) at 29.

who are the top experts in GPS.[7] As LightSquared points out, the M code occupies spectrum all of the way to the lower band edge of the frequencies used for GPS (1559 MHz). This is clearly incompatible with LightSquared's proposed operations in the Upper 10 MHz of spectrum, which would transmit massive amounts of power a scant 4 MHz away. GPS satellites of the Block IIR-M variety transmit the M code, the first of which was placed into orbit on September 26, 2005. The fact that this launch occurred over six years ago undermines LightSquared's repeated assertions that the GPS Industry should have anticipated high-power, primary terrestrial transmissions in satellite spectrum adjacent to GPS. Moreover, it further demonstrates LightSquared's lack of diligence in initially proposing to use the Upper 10 MHz, which will certainly cause destructive interference to military operations.

LightSquared September 27, 2011 Response:

. . . The M code will have up to 20 dB higher power when necessary on a regional basis for enhanced reliability, including possible interference . . . .

Garmin Response:

Barker states that the 20 dB of extra power is a spot beam to provide greater power in a localized region, presumably to help the US military conduct operations in a hostile RF environment when an adversary is jamming the system. It is very ironic that LightSquared suggests using a special purpose capability designed to overcome enemy jamming during warfare to accommodate the jamming created by LightSquared's system in the United States. The military did not contemplate protecting itself from domestic interference generated by a civilian system during peacetime the way that LightSquared now proposes.

LightSquared September 27, 2011 Response:

. . . Two civil signals in the new L1C signal structure main lobes fall between 0-6 MHz of center frequency [sic] thus, have most of their power within the bandwidth of the M code or the soon to be obsolete P code. Regarding capture of the full extent of the upper and lower side lobes to enhance precision or reject multipath, we note that the new satellite spectra all fall within a 31 MHz (currently migrating from 24 MHz) transmitter bandwidth that is centered at 1575.42 MHz. These factors define the key GPS passband phase and amplitude responses for purposes of specifying transition band rejection filters to establish or enhance compatible operation. Similar transmission and channel parameters exist for other GNSS systems . . . .

[7] B.C. Barker, et al., "Overview of the GPS M Code Signal," *Proceedings of the ION 2000 National Technical Meeting*, Institute of Navigation, January 2000 ("Barker").

Garmin Response:

This discussion is notable in that it leaves out other GNSS systems that operate in other parts of the RNSS band, such as GLONASS and the COMPASS systems. For example, the GLONASS system occupies spectrum between 1598.0625 MHz and 1606.5 MHz. The COMPASS signal will be centered at 1561.098 MHz. Implying use of a filter with a pass band of 31 MHz centered at 1575.42 MHz to reject LightSquared transmissions will eliminate any possibility of interoperability with other navigation services in different parts of the RNSS band such as GLONASS and COMPASS.[8] To the contrary, reception of other GNSS systems improves the performance of location devices and should be promoted, not restricted.

LightSquared September 27, 2011 Response:

. . . Though they lie outside the L1 [sic] most relevant here, new, state-of-the-art receivers will also achieve greater accuracy, multipath mitigation and reliability as they migrate their receiver architectures to multiband and multi-constellation operation, that include new open, unencrypted civil L2C signals which for Precision receivers significantly improves tracking at lower C/No than current Receivers . . . .

Garmin Response:

L2C is not fully deployed and does not represent a viable mitigation. There are currently only nine healthy satellites capable of broadcasting the L2C signal. It will be many years, if not a decade, before the number of satellites broadcasting L2C reaches a level rivaling the global capability of the 32 healthy satellites broadcasting the L1 C/A code signal that are affected by LightSquared transmissions.

LightSquared Response:

. . . Along with other receivers, Precision receivers will also have access to a new L5 frequency signal set . . . .

Garmin Response:

There are currently only two GPS satellites with healthy status actually in orbit and capable of broadcasting the new L5 signal.

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[8] Furthermore, in a public notice from September 2008, the Department of Defense committed to supporting codeless/semi-codeless access to the GPS P(Y) signals until December 31, 2020 which represents the planned availability of the second and third coded civil GPS signals being broadcast from a minimum of 24 GPS satellites. *See* Office of the Secretary, Department of Defense, "Preservation of Continuity for Semi-Codeless GPS Applications," 73 Fed. Reg. 54792 (Sept. 23, 2008). The Department of Defense will reassess the transition date should significant GPS program delays arise.

LightSquared Response:

Based on the above facts and trends, we therefore reject a view that the Lower 10 MHz terrestrial downlink will somehow limit continuation of GPS or GNSS evolution.

Garmin Response:

This statement ignores the fact that a large part of the evolution of GPS and GNSS systems has taken place at L1. A huge investment has been made for modernization of GNSS systems in the L1 spectrum. Additionally, the L1 and L5 bands are the only GNSS frequencies that are designated for exclusive use by the Aeronautical Radionavigation Service and thereby suitable for safety-of-life aviation operations. Undermining the viability of GPS operations in L1 also undermines the future benefits that are anticipated from the use of dual-frequency aviation receivers. The LightSquared terrestrial transmissions <u>are</u> a problem for the L1 band and <u>will</u> hinder the modernization of GNSS systems.