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VIA ELECTRONIC DELIVERY

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

**Re: *Ex Parte* Letter
GN Docket No. 13-114; RM-11640**

Dear Ms. Dortch:

Gogo Inc. (“Gogo”) submits this letter in the above-referenced dockets to provide the Commission with a more detailed analysis supporting its proposal for a flexible auction that makes available four 125 MHz licenses for the provision of air-to-ground (“ATG”) service in the 14 GHz band.¹ As discussed below, such a proposal is technically viable and is needed to ensure participation in the auction by less well-financed entities and promote continued, vibrant competition in the in-flight connectivity market. Gogo also addresses in this letter technical issues that were raised by the Satellite Industry Association (“SIA”) and Qualcomm Incorporated (“Qualcomm”) in recent *ex parte* submissions.

Background. For purposes of this submission, Gogo has used the baseline 14 GHz Air-Ground Mobile Broadband Service (“AGMBS”) system characteristics described by Qualcomm in its filings in this proceeding to compare the capabilities of an ATG service allocation having two 250 MHz licenses (as proposed by Qualcomm) and one having four 125 MHz licenses (as proposed by Gogo). Gogo notes that the architecture proposed by Qualcomm is technically feasible and has sufficient detail to ensure that systems can be designed and constructed to provide protection to other services in the 14.0-14.5 GHz band. Gogo further notes, as Qualcomm itself has recognized, that Qualcomm’s illustrative AGMBS design has not necessarily been optimized for performance, capacity and economic factors specific to any particular market segment.² Licensees should be

¹ Gogo previously proposed this in its comments and in an *ex parte* meeting with Commission staff. See Comments of Gogo Inc., GN Docket No. 13-114 (Aug. 26, 2013) (“Gogo Comments”); Letter from Michele Farquhar, Hogan Lovells, to Marlene Dortch, Secretary, FCC, GN Docket No. 13-114 (Mar. 28, 2014) (“Gogo *Ex Parte* Notice”).

² See Reply Comments of Qualcomm, RM-11640 (Oct. 14, 2011), at iii (“The detailed technical description in Appendix A is purely intended to explain how, in Qualcomm’s view, such a system can be

allowed the flexibility to modify the baseline design to meet the interference objectives, while reflecting their individual marketplace perspectives on the trade-offs of other factors such as development timelines, network economics, performance and capacity. As Gogo has stated previously, the rules should be designed in a flexible, technology-neutral fashion that does not require the reliance on a proprietary solution.³

125 MHz licenses would provide robust service to passengers. The service level to an aircraft is dependent upon the capacity of a single beam. A 100 MHz beam, as proposed by Qualcomm, can be supported using either a 125 MHz or a 250 MHz license⁴ and would be capable of providing service rates on the order of 100 Mbps per beam. Accordingly, in terms of service to passengers, the baseline design under either license proposal would provide comparable service.

125 MHz licenses would have more than adequate network capacity. The baseline design can provide an aggregate throughput in the forward and reverse links of 500 Gbps.⁵ This suggests a conservative estimate of 100 Gbps of forward link capacity for a 125 MHz license.⁶ Compared to existing systems, each 125 MHz license can provide over 16 times the peak capacity of Gogo's current ATG/ATG-4 network,⁷ and over 110 times the capacity of conventional Ku-band satellite systems.⁸ Gogo believes this is more than adequate for most competitive AGMBS networks.

Despite coordination restrictions, 125 MHz licenses at either end of the 14 GHz band would provide ample capacity. There are three coordination/protection requirements in the 14.0-14.5 MHz band: 1) the Space Research Service at 14.0-14.05 GHz (*i.e.* NASA's Tracking and Data Relay Satellite System ("TDRSS")); 2) federal mobile and fixed services at 14.4-14.5 GHz; and 3) Radio Astronomy Services ("RSA") at 14.47-14.5 GHz. Qualcomm has stated that "[i]n light of the necessary coordination with incumbents in the 14.0 - 14.5 GHz band, particularly TDRSS at the lower end and RAS at the upper end, it is not technically viable to have four 125 MHz licenses support four separate air-ground networks, as Gogo proposes, because there would not be sufficient capacity to reliably provide a nationwide broadband service."⁹ Qualcomm provided no analysis to support this claim. As demonstrated below, Gogo's analysis makes it clear that all four 125 MHz licenses would be technically viable, despite the impact of the coordination requirements.

designed to successfully operate in the 14 GHz band. It is by no means the only way to deploy a high-data-rate air-ground communications system at 14 GHz.").

³ See Comments of Gogo, GN Docket No. 13-114 (Aug. 26, 2013), at 17-18.

⁴ The use of five 20 MHz carriers for an aggregate of 100 MHz per beam is frequently referenced by Qualcomm. See, *e.g.*, Letter from John W. Kuzin, Senior Director, Government Affairs—Regulatory, Qualcomm, to Marlene Dortch, Secretary, FCC, RM-11640, Attach. at 33, 37 (filed Oct. 2, 2012).

⁵ This is based on 250 AGMBS sites with 4 co-channel beams/site. See Letter from John W. Kuzin, Senior Director, Government Affairs—Regulatory, Qualcomm, to Marlene Dortch, Secretary, FCC, RM-11640, Attach. at 2 (filed Jan. 18, 2013).

⁶ 500 Gbps in 500 MHz yields 125 Gbps in 125 MHz aggregate forward and reverse links. Assuming a 4:1 forward link to reverse link ratio, there would be 100 ($=125*4/(4+1)$) Gbps of forward link capacity.

⁷ This is approximately 6 Gbps and is based on 205 CONUS sites, 6 sectors/site and 4.9 Mbps/sector.

⁸ This is based on the estimated availability of 50 CONUS transponder equivalents, with 30 used for forward links, at peak capacity of 30 Mbps/transponder equivalent (*i.e.*, 900 Mbps aggregate forward link).

⁹ Reply Comments of Qualcomm, GN Docket No. 13-114 (Sept. 23, 2013), at 10.

1. Space Research: Qualcomm provided an extensive analysis of the potential for aircraft and ground station interference into the Space Research TDRSS facilities.¹⁰ As the FCC has noted, this analysis was unchallenged.¹¹ Qualcomm's analysis notes that the probability of an aircraft being in a TDRSS beam, and thus required to avoid the use of the 50 MHz of spectrum at the lower end of the spectrum block, is 1.5E-6, or 0.0000015%. Qualcomm also notes that the resulting bandwidth restrictions would last about only 0.25 seconds at normal cruise speeds. Accordingly, these TDRSS-related restrictions would have no significant impact on the overall utility of a 125 MHz block at 14.0-14.125 GHz.

2. Federal Services: The federal services which are permitted on a secondary basis are limited to 13 Fixed Service and 12 Mobile Service assignments.¹² The FCC invited comments regarding any technical rules or coordination procedures required to provide appropriate interference protection to these services.¹³ The lack of comments over the last two and one half years indicates that the operators of these services perceive no risk from or to the proposed AGMBS operations, and the Federal allocation should have no impact on the size and number of spectrum blocks. Independent of the issue of license sizes, Gogo believes that the FCC should proactively ensure that any coordination requirements are well defined prior to auction in order to assure that bidders are fully aware of coordination requirements.

3. Radio Astronomy: In connection with receiving its Earth Stations Aboard Aircraft ("ESAA") blanket license, Gogo has executed a coordination agreement with the National Science Foundation ("NSF") under which Gogo has agreed to ensure that aggregate PFD limits of -221 dB(W/m²/Hz) (for the Greenbank and Socorro sites) and -189 dB(W/m²/Hz) (for very long baseline array sites) in the 14.47 -14.5 GHz band are not exceeded during periods of radio astronomy observations.¹⁴

Ground station locations will need to be chosen and coordinated so that RAS installations are adequately protected. Ground station PFD limits may be lower than the ESAA limits due to the range of elevation angles used for astronomical observations, but, assuming levels comparable to those noted above, there are a number of ways to assure that such limits can be met, including:

- Selection of base station sites with adequate terrain blockage towards RAS installations;
- Use of antenna uptilt to add discrimination towards the horizon (and towards RAS installations); and

¹⁰ Petition for Rulemaking of Qualcomm, RM-11640, App. A at A-37-41 (filed July 7, 2011).

¹¹ *Expanding Access to Broadband and Encouraging Innovation Through Establishment of an Air-Ground Mobile Broadband Secondary Service for Passengers Aboard Aircraft in the 14.0-14.5 GHz Band*, Notice of Proposed Rulemaking, 28 FCC Rcd 6765, 6776 ¶ 34 (2013).

¹² *Id.* at ¶ 15.

¹³ *Id.* at ¶ 45.

¹⁴ See Amendment of Gogo to Application for Blanket Authority for Operation of 1000 Technically Identical Ku-Band Transmit/Receive Earth Stations in the Aeronautical Mobile Satellite Service, FCC File No. SES-AMD-20120731-00709, Tech. App. at 13 (filed July 31, 2012).

- Use of spatial diversity sites coupled with inhibiting beam use from the nearest base station in the direction of the RAS installation. In order to ensure coverage for aircraft in the immediate vicinity of an RAS installation, site layout will be constrained to ensure that at least one site can provide service to such areas while being positioned with adequate isolation to permit pointing at the RAS installation.

As Qualcomm noted, an exclusion zone of up to 500 km will be needed for aircraft. Gogo would further note that exclusion zone requirements will be smaller for aircraft operating at lower than the highest cruising altitudes. Given that many of the RAS installations are in the southwest corner of the country, as shown in Figure 1 below, Gogo estimates that roughly one-half of the country would be nominally impacted by aircraft exclusion zones. However, for any license block which includes the 14.47-14.5 GHz band, providing RAS protection may be accomplished by not assigning reverse link spectrum within the upper two 20 MHz channels when an aircraft is within an exclusion zone that is determined by aircraft altitude.



Figure 1 - 500 km exclusion zones surrounding CONUS RAS installations

Because base station locations can be configured to avoid interference with RAS installations, there is no impact on forward link capacity. Since reverse link capacity requirements are generally significantly less than those for forward links, the restrictions on spectrum used within exclusion zones will have no practical impact on reverse link capacity. However, in the unlikely event that reverse link requirements dominate overall capacity requirements, a licensee will always have the option of adding additional capacity sites.

In summary, Gogo's analysis indicates that RAS considerations will have little impact on the utility of the upper 30 MHz of spectrum, regardless of whether that spectrum is part of a 125 MHz block or a 250 MHz block.

Not every provider needs 250 MHz of spectrum. By setting 250 MHz as the minimum license size, spectrum may not be used efficiently, and fewer competitors will have an opportunity to provide ATG service in the 14 GHz band. As explained above, a 125 MHz license will offer more than adequate capacity for the provision of ATG service. A 250 MHz license is simply more than

many potential providers will need – particularly existing providers, like Gogo, who may wish to acquire a 14 GHz license to supplement existing satellite or ATG spectrum.

These licenses offer the potential for aircraft communications systems with large bandwidth capabilities, low latency, and low installation costs. Such capabilities can be expected to supplement current services, and/or open additional markets that are not currently well served or penetrated, including private aircraft, commercial airlines operations, and various government and military services. All of these diverse sectors represent legitimate business opportunities for different types of providers and are likely to be better served by four licensees rather than two.

There are enough interested parties to support a four-license auction. The market for in-flight connectivity is already competitive, and more parties are showing interest in the market. As indicated above, the bandwidth and cost advantages available with a 14 GHz terrestrial system could make a 14 GHz license an appealing add-on for any existing provider, as well as providing a solid spectrum base for new entrants to launch service.

In addition to Gogo, current, and past providers of in-flight broadband in the U.S. and elsewhere include Panasonic, Row 44, LiveTV, ViaSat, Boeing, Verizon, ARINC, and OnAir. Significantly, AT&T recently announced that it plans to enter the domestic ATG market by using its terrestrial spectrum.¹⁵ This serves as another validation of the robust demand and significant future growth prospects for this industry as companies such as AT&T that are not current participants in this industry want to enter this market. New and current players may likewise be mulling entry or expansion into this market and could see this auction as a great opportunity to do so – *if* they see that there is a reasonable opportunity to acquire a license.

Furthermore, by permitting the aggregation of up to two 125 MHz licenses at auction, as Gogo has proposed,¹⁶ the FCC can help ensure a competitive auction, even if there are relatively few bidders.

A flexible auction will promote competition and enable participation by smaller providers. In addition to not *needing* 250 MHz of spectrum, many potential bidders may not be able to *afford* a 250 MHz license, especially if they are bidding against extremely large corporations who wish to pursue a monopoly or duopoly in this band. While the in-flight connectivity business does not lend itself to participation by truly “small” businesses, the largest and smallest companies likely to be interested in the auction differ in size dramatically, creating significantly different levels of financial ability.

It is clear that the larger players in this sector would have the financial ability to dominate any 14 GHz auction. It is essential, therefore, that the Commission limit spectrum aggregation at the auction to 250 MHz, so that a single bidder cannot obtain the entire band, which would greatly restrict competition.¹⁷ It is also critically important to provide the option for four licenses, so that providers (whether existing or new) with smaller financial resources will have a realistic opportunity of obtaining a 14 GHz band license. Creating a flexible auction that permits up to four licenses is the

¹⁵ See *Mobilizing the Sky: AT&T Building 4G LTE In-Flight Connectivity Service*, AT&T (Apr. 28, 2014), http://about.att.com/story/mobilizing_the_sky_att_building_4g_lte_in_flight_connectivity_service.html.

¹⁶ See Gogo *Ex Parte* Notice.

¹⁷ Gogo has also suggested that this aggregation limit could be relaxed three years after the auction. See Gogo Comments at 7.

only way the Commission can fulfill its statutory obligation to “avoid[] excessive concentration of licenses” and “disseminat[e] licenses among a wide variety of applicants.”¹⁸

Finally, the spectrum aggregation limit and four license option is likely to increase auction revenues by enticing a greater number of bidders into the auction. If only two 250 MHz licenses are offered, it will send a signal to smaller entities that they need not bother applying.

Three license option. If, despite the arguments above, the Commission is still hesitant to offer four separate licenses, it should consider offering three licenses – one 250 MHz license and two 125 MHz licenses. This would still enable bidders to choose the most appropriate license size for their needs and financial ability, while reducing any potential concerns associated with a four-license offering. This structure might also be appropriate if the FCC determines that coordination with Federal fixed and mobile service assignments (the details of which are not publically available) would have an unexpectedly large impact on spectrum at 14.4 -14.5 GHz, and that a license block at 14.375-14.5 GHz would therefore be technically limited from providing a useful amount of capacity over CONUS.

Technical satellite protection issues. Below, Gogo addresses a number of technical issues that have been discussed recently by SIA and Qualcomm in the proceeding.

- *ΔT/T considerations.* Gogo supports the proposed §21.1120 requirement that interference from all air-ground mobile broadband aircraft and base stations not exceed a 1% rise over thermal (ΔT/T). The SIA has provided no rationale for establishing an interference level allocation of 1/3 of 1% for the AGMBS service; it appears to be based on speculation that all secondary services will have an equal level of interference impact.¹⁹ However, no comments have been received from other operators of other secondary services that have indicated that they generate any level of interference that would require a reduction of the FCC's proposed 1% limit.
- *Maximum G/T.* Gogo supports the SIA position that 6 dB/K be used for determining the allowable interference levels that will be incorporated into the final version of §21.1120.²⁰ Gogo believes that this will also provide some amount of margin over the actual average G/T for the satellite that is identified as the worst case (SES-2).
- *Protecting GSO systems from harmful interference.* The FCC should clarify §21.1120 to ensure that licensees are not constrained in how the aggregate interference limits are met. The proposed rule states that “[t]his one percent ΔT/T limit *may* be met by complying with subsections (a), (b), and (c) below:” (emphasis added), and then states a series of constraints that reflect the illustrative system proposed by Qualcomm.

Gogo believes that it is more desirable to state the maximum aggregate spectral density towards any satellite in the GSO arc, while leaving the licensee the freedom to allocate that aggregate level over the base stations and aircraft that are deployed. That maximum can be

¹⁸ 47 U.S.C. § 309(j)(3)(B).

¹⁹ See Comments of Satellite Industry Association (“SIA”), GN Docket No. 13-114, RM-11640, at 7 (filed Aug. 26, 2013) (“Permissible aggregate interference level is set at 0.33% ΔT/T (or ‘Rise over Thermal’) interference from all non-primary sources.”).

²⁰ Letter from Patricia Cooper, President, SIA, to Marlene H. Dortch, Secretary, FCC, RM-11640, at Exh. 1 (filed Mar. 5, 2013).

specified in the first paragraph of §21.1120, and subsections (a), (b) and (c) can be eliminated. Alternatively, the language can be modified to clarify that licensees are free to establish alternative allocations for base stations and aircraft terminals, with considerations for factors such as aircraft roll and rain fade compensation, that are consistent with the aggregate limits required to protect satellite operations. It is not necessary to specify limits on individual aircraft and/or beams, as such limits would represent one means, but not the only means, to achieve the aggregate protection limit. Qualcomm has suggested an approach that moves in this direction,²¹ but its proposed modifications are still based upon its illustrative system, reflecting implicit constraints on such factors as the number of sites and the number of beams per site.

- *Satellite protection.* Qualcomm has proposed an additional rule §21.1124, "Air-Ground Mobile Broadband System Antenna Performance."²² This proposal provides that documentation be maintained to demonstrate that emission limits toward the GSO arc are not exceeded, including the maintenance of various antenna patterns. Qualcomm further proposes that licensees shall file a report within six months of initiating substantial service, describing the aggregate EIRP density levels from the operation of the system.²³ Qualcomm also proposes that operators be required to demonstrate that aircraft terminals will cease transmission upon loss of synchronization or within 5 seconds of loss of reception from the base station, and are capable of adjusting transmit power within 100 ms if necessary to ensure that aggregate emission limits toward the GSO arc are met under roll conditions.²⁴ The SIA has expressed concern that these measures will not provide adequate protection for satellite services and suggests that the rule for cessation of transmissions should be more stringent, citing the 100 ms rule for mobile services in this band.²⁵

To some extent, Gogo agrees with Qualcomm's proposition that the rules must provide a protection mechanism, and also agrees in part with the SIA position that the proposed rule does not adequately ensure protection of satellite operations. Gogo also notes that, once again, the proposed regulations reflect the design approach outlined by Qualcomm.

Gogo suggests that the proposed §22.1124 be modified to require the filing of a report with the Commission at least six months prior to placing a system into service, with sufficient information to demonstrate that the system will afford the required level of protection to existing satellite systems. This information must include sufficient data on antenna patterns and power control management, spectrum resource management and exception management, to demonstrate that: i) initial system implementation will comply with interference limits, and ii) network growth plans can be accommodated without compromising those limits. This approach will ensure that AGMBS systems provide adequate protection for satellite operations before the AGMBS systems go into service. Gogo notes that Qualcomm has provided, in filings in this proceeding, a reasonable example

²¹ Letter from John W. Kuzin, Senior Director, Government Affairs—Regulatory, Qualcomm, to Marlene Dortch, Secretary, FCC, GN Docket No. 13-114, RM-11640 (filed Dec. 11, 2013).

²² *Id.*, Attach. at 8-9.

²³ *Id.*, Attach. at 9.

²⁴ *Id.*

²⁵ See Letter from Patricia Cooper, President, Satellite Industry Association, to Marlene Dortch, Secretary, FCC, GN Docket No. 13-114, RM-11640 (filed May 21, 2014).

of how this can be shown.²⁶ Gogo anticipates that similar showings demonstrating adequate protection to satellite operations can be made based on variations on Qualcomm's illustrative system.

With respect to the requirements for the cessation of transmissions and the response time for adjusting transmit power under aircraft roll conditions, Gogo believes that both these issues should be covered within the report described in the preceding paragraph. The SIA position with respect to strict rules similar to those for mobile satellite services (*i.e.*, Vehicle-Mounted Earth Stations, Earth Stations Aboard Aircraft, and Earth Stations on Vessels) is not appropriate,²⁷ given that individual AGMBS aircraft terminals will likely not have the same disruptive potential. A single mobile service terminal, with a highly directive antenna and relatively high EIRP is capable of causing interference to an adjacent satellite with a small amount of mis-pointing.

In contrast, the Qualcomm illustrative system has relatively wide aircraft antenna beamwidths and low EIRPs, such that potential interference is more likely to be due to the aggregation of interfering signals from multiple aircraft terminals.²⁸ The rate of power level adjustments required to ensure that limits are met under aircraft roll conditions will also be dependent upon the maximum roll rate of aircraft, the patterns of the antenna employed, and the overall power control management system utilized. A 100 ms limit appears to be entirely arbitrary, and licensees should be allowed to establish an adjustment period that is adequate to ensure that their system will continuously meet interference limit requirements. Gogo also notes that synchronization with the base station can only be ensured if a received signal is present, and Gogo considers it likely that most system designs will mute transmission based on loss of synchronization rather than on a timer after the loss of reception.

Rather than advocating any particular set of constraints, Gogo suggests that licensees be required to provide details of their control techniques in a filing with the Commission, as outlined above. This will provide a flexible, technology-neutral approach while still providing interested parties with an opportunity to comment on the proposed protection mechanisms.

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²⁶ See, e.g., Reply Comments of Qualcomm, RM-11640, at App. A (filed Jul. 31, 2012).

²⁷ See Letter from Patricia Cooper, President, SIA, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 13-114, RM 11640, at 4 (filed May 21, 2014).

²⁸ See Letter from John W. Kuzin, Senior Director, Government Affairs—Regulatory, to Marlene H. Dortch, Secretary, FCC, RM-11640, Attach. at 7 (filed Sept. 14, 2014) (describing interference from AG aircraft to GEO-ARC).

I am filing this letter electronically in the above-referenced dockets. Please contact me directly with any questions.

Respectfully submitted,

/s/ Michele C. Farquhar

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