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February 7, 2014

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

Re: 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; GN Docket No. 13-114, RM-11640

Dear Ms. Dortch:

Qualcomm hereby submits a proposed regulation in the above-referenced proceeding that would ensure successful spectrum sharing with potential future NGSO satellite systems in the 14.0 to 14.5 GHz band. While, as the Commission knows, “there are no planned NGSO systems in the[] band[],” NPRM at ¶ 15, the proposed rule acknowledges that an NGSO system could be deployed at some future point in time.

As noted in the Air-Ground Mobile Broadband Service NPRM, Qualcomm demonstrated how the proposed service would protect a typical future NGSO system (*i.e.*, one that operates at elevation angles greater than 15 degrees) from harmful interference by maintaining the $\Delta T/T$ to below one percent. *See* NPRM at ¶ 105. An NGSO system that operates at very low elevation angles, *i.e.*, below 15 degrees, would be uncommon. In fact, it would be very unusual for an NGSO system to operate at elevation angles below 10 degrees.¹

NGSO earth stations typically do not operate at low elevation angles because they would encounter buildings, trees, and other terrestrial objects that could block the line of sight to the NGSO satellite. Also, electrical noise generated close to the earth’s surface in horizontal directions, such as from microwave links, adversely affects satellite reception, and atmospheric attenuation increases at low elevation angles. For these reasons, NGSO satellite systems would

¹ *See* Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range and Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licensees and Their Affiliates, *NPRM*, 14 FCC Rcd 1131, 1144 (1998) (“SkyBridge indicates that since the elevation angle of a fixed service station is generally less than a few degrees and **NGSO satellite beams typically would not be directed at such low elevation angles towards the Earth**, mainbeam-to-mainbeam interference from NGSO satellite transmitters should not occur. SkyBridge claims that there would be a low probability of an NGSO satellite at a low elevation angle passing through the mainbeam of a fixed service receiver pointed towards the horizon, *i.e.*, 0.001% of the time. Further, **SkyBridge argues that the NGSO satellite’s antenna gain decreases rapidly at elevation angles less than 10 degrees so that the magnitude of the interfering signals would be small.**”) (emphasis added).

typically employ antenna gain that rapidly decreases for low elevation angles in order to limit the impact of interfering signals both to and from the earth's surface.²

Qualcomm recommended that the Commission set the maximum $\Delta T/T$ that the Air-Ground Mobile Broadband Service may generate into an NGSO system to six percent because it is possible for the new service to cause the $\Delta T/T$ of an NGSO system that is providing service at very low elevation angles to exceed one percent. In fact, the only time that the new Air-Ground Mobile Broadband Service would cause the $\Delta T/T$ of the NGSO system to exceed one percent would be if the NGSO system is providing service at elevation angles below 10 degrees, a scenario that, as noted above, would be very unusual.

Qualcomm demonstrated that a six percent limit will benefit the Air-Ground Mobile Broadband system and not impose any real burden on a NGSO system when that system is operating at low elevation angles, while a one percent limit would impose severe constraints on the Air-Ground Mobile Broadband system with no real corresponding benefit to a future NGSO system. To the extent a future NGSO satellite system is designed and deployed to operate at elevation angles below 10 to 15 degrees, the system can be designed to accept an aggregate $\Delta T/T$ of six percent with a negligible performance or cost impact. *See* Qualcomm Comments at 31-33; Qualcomm Reply Comments at 31-37 (showing that the difference between handling a 1% versus a 6% $\Delta T/T$ to an NGSO satellite is ~0.2 dB and may be addressed by allowing the NGSO earth stations to use 0.2 dB greater EIRP, which is a negligible additional cost for the small percentage of time that the condition exists).

Nevertheless, below Qualcomm proposes new Rule Section 22.1121, which would limit the $\Delta T/T$ into a future NGSO satellite system to one percent and require the NGSO satellite system licensee to coordinate operations with the Air-Ground Mobile Broadband licensee(s) to the extent it seeks to operate at elevation angles below 8 degrees. To comply with these levels, the Air-Ground Mobile Broadband base station beam may turn its power down, or off, as appropriate, when it causes the aggregate $\Delta T/T$ of the NGSO system to exceed the one percent level. The Air-Ground Mobile Broadband system operator would need to use the NGSO system G/T and antenna pattern parameters to compute the aggregate increase in interference ($\Delta T/T$) when the Air-Ground Mobile Broadband base station is in line with the NGSO receive satellite.

§ 22.1121 Protecting Future NGSO Satellite Systems from Harmful Interference from Air-Ground Mobile Broadband stations.

- (a) The aggregate increase in interference ($\Delta T/T$) from all simultaneous transmitting components of the Air-Ground Mobile Broadband system (*i.e.*, air-ground mobile

² *See, e.g.*, Northrop Grumman Space & Mission Sys. Corp., *Order and Authorization*, 24 FCC Rcd 2330, 2349-50 (2009) (“NGSO operations in the 37.5-40.0 GHz band, however, exceed the “clear-air” PFD limits for elevation angles between approximately 11 and 22 degrees.

Nevertheless, **since Northrop Grumman’s system employs very narrow antenna beams, it should be possible for Northrop Grumman to operate only those satellite antenna beams that can be received by earth stations at sufficiently high elevation angles to meet the PFD limits.** Because Northrop Grumman did not submit a waiver request to operate at PFD limits above the specified values, we will permit Northrop Grumman to operate its NGSO satellites in the 37.5-40.0 GHz band only when the NGSO satellites meet the clear-air PFD limits, *i.e.*, at elevation angles to the NGSO satellites that are greater than 22 degrees.”) (emphasis added).

broadband aircraft, and base stations, or both including duty cycle effects) into the uplink of a primary NGSO satellite system shall not exceed one percent.

- (b) If the NGSO satellite system operator plans to provide service within the Continental United States at elevation angles below eight degrees, the NGSO satellite system licensee(s) shall contact the Air-Ground Mobile Broadband licensee(s) at least 180 days prior to commencing NGSO operations to coordinate with the Air-Ground Mobile Broadband licensee(s) in lieu of complying with this rule section.
- (c) This rule section will become operative once a NGSO satellite system licensee commences operation in the 14.0 to 14.5 GHz band.

Thus, the proposed rule would limit to 1 percent the aggregate increase in interference $\Delta T/T$ into the NGSO satellite uplink, and to the extent the NGSO licensee seeks to operate at elevation angles below eight degrees — which would be very unusual given that eight degrees is the lowest elevation that SIA itself has identified³ — the proposed rule requires the NGSO licensee to coordinate its operations with the Air-Ground Mobile Broadband licensee. Finally, in the alternative, should the FCC prefer not to include proposed subsection (c) in the text of the rule, Qualcomm suggests that the agency state in the Order adopting the Air-Ground Mobile Broadband Service rules that the rule will not be enforced until an NGSO satellite system is operating in the 14.0 to 14.5 GHz band.

Qualcomm encourages the FCC to promptly issue a Report and Order establishing the Air-Ground Mobile Broadband Service on a secondary licensed basis in the 14.0 to 14.5 GHz band, and, as soon as possible thereafter, schedule an auction of the secondary licensed spectrum. An increasing number of airline passengers are demanding the same level of broadband Internet access in the air that they currently enjoy on the ground, and the proposed Air-Ground Mobile Broadband service will amply satisfy that demand.

Respectfully submitted,

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³ See SIA Comments, Technical Annex (filed Aug. 26, 2013) at 14, n.11 (current NGSO systems in other bands do not operate at elevation angles below 8 degrees: “Iridium operates down to 8° elevation and Globalstar down to 10° elevation.”).