

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, DC 20554**

|   |   |          |
|---|---|----------|
| In the Matter of                            | ) |          |
| Amendment of the Commission's Rules to      | ) |          |
| Establish a Next-Generation Air-Ground      | ) | RM-11640 |
| Communications Service on a Secondary       | ) |          |
| Licensed Basis in the 14.0 to 14.5 GHz Band | ) |          |

**COMMENTS OF THE SATELLITE INDUSTRY ASSOCIATION**

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## SUMMARY

The Satellite Industry Association (“SIA”), the leading U.S.-based trade association advising on policy, regulatory and legislative issues affecting the global satellite industry, hereby submits its comments in response to the Commission’s May 15, 2012 Public Notice seeking input from the satellite industry on the technical information provided by Qualcomm, Incorporated (“Qualcomm”) regarding its petition for rulemaking to establish a new air-to-ground (“ATG”) communications service on a secondary basis in the 14.0–14.5 GHz band to support in-flight passenger communications onboard commercial aircraft.

While substantial technical work has been conducted in connection with the proposed ATG concept, numerous deficiencies remain in the technical information submitted by Qualcomm. Given the absence of basic technical characteristics, as well as gaps and unsupported assumptions in its spectrum sharing analysis, it is not possible for interested parties to adequately assess the interference impacts of Qualcomm’s complex proposal, other than to say that the interference to and from primary FSS services in the 14.0–14.5 GHz is likely to be greater than predicted. These uncertainties are exacerbated by the unprecedented suggestion to assign secondary licenses via auction in a band heavily used by existing FSS operators with primary status that support a wide range of government and commercial fixed, temporary fixed, land mobile, maritime mobile and aeronautical mobile applications.

Importantly, Qualcomm has not demonstrated that a new, secondary ATG service in the 14.0–14.5 GHz band is needed to meet demand for in-flight passenger connectivity. In particular, Qualcomm has not shown that demand for in-flight passenger connectivity cannot be met by terrestrial or satellite-based deployments in existing frequency allocations that do not pose the same sharing difficulties as the proposed secondary ATG service. Indeed, the 14.0–14.5

GHz band is already being used to provide in-flight passenger connectivity using FSS satellite capacity. The introduction of Qualcomm's ATG service in the same band may well "spoil" the band for both services, resulting in less robust competition in the provision in-flight passenger connectivity than would otherwise be the case.

For all of these reasons, SIA believes that the initiation of a rulemaking proceeding on Qualcomm's ATG service is not warranted at this time.

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To: The Commission

**COMMENTS OF THE SATELLITE INDUSTRY ASSOCIATION**

The Satellite Industry Association (“SIA”) respectfully submits these comments in response to the May 15, 2012 Public Notice seeking comment on the technical information provided by Qualcomm, Incorporated (“Qualcomm”) regarding the above-captioned Petition for Rulemaking (“Petition”).<sup>1</sup> SIA is a U.S.-based trade association providing worldwide representation of the leading satellite operators, service providers, manufacturers, launch services providers, and ground equipment suppliers.<sup>2</sup> Since its creation fifteen years ago, SIA has

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<sup>1</sup> “International Bureau Seeks Further Comment on Qualcomm Petition for Rulemaking,” *Public Notice*, DA 12-767 (rel. May 15, 2012) (“*May 15<sup>th</sup> Public Notice*”). The comment date was extended by the Commission to July 16, 2012 in response to a petition from SIA. See Letter of James L. Ball, Chief, Policy Division, International Bureau, Federal Communications Commission, to Patricia Cooper, President, Satellite Industry Association, DA 12-835 (May 25, 2012).

<sup>2</sup> SIA Executive Members include: Artel, Inc.; The Boeing Company; The DIRECTV Group;; DBSD North America, Inc.; EchoStar Satellite Services L.L.C.; Harris CapRock Communications; Hughes Network Systems, LLC; Integral Systems, Inc.; Intelsat, Ltd.; Iridium Communications Inc.; LightSquared; Lockheed Martin Corporation.; Loral Space & Communications, Inc.; Northrop Grumman Corporation; Rockwell Collins Government Systems; SES; and TerreStar Networks, Inc. SIA Associate Members include: Arqiva Satellite and Media; ATK Inc.; Cisco; Cobham SATCOM Land Systems; Comtech EF Data Corp.; DRS Technologies, Inc.; Eutelsat, Inc.; GE Satellite; Globecom Systems, Inc.; Glowlink Communications Technology, Inc.; iDirect Government Technologies; Inmarsat, Inc.; Marshall Communications Corporation.; Orbital Sciences Corporation; Panasonic Avionics Corporation;

become the unified voice of the U.S. satellite industry on policy, regulatory and legislative issues affecting the satellite business.

In the Petition, Qualcomm asked the Commission to begin a proceeding to establish a new terrestrial-based, air-to-ground (“ATG”) mobile service on a secondary basis in the 14.0–14.5 GHz band -- the portion of the Ku-band currently allocated to the Fixed-Satellite Service (“FSS”) on a primary basis for Earth-to-space (uplink) transmissions -- to support in-flight passenger communications onboard commercial aircraft.<sup>3</sup> In the *May 15th Public Notice*, the Commission invited satellite systems operators to (1) comment on whether the materials provided by Qualcomm sufficiently respond to the interference concerns and support Qualcomm’s request to initiate a rulemaking, (2) provide a technical evaluation of Qualcomm’s interference analysis, (3) comment on the feasibility of the operation of one or more air-ground systems in the 14.0–14.5 GHz band on a secondary basis, (4) comment on Qualcomm’s proposed solutions to identifying the air-ground system as the source, if interference should occur, and (5) comment on the types of rules the Commission would need to impose on the proposed air-ground system to ensure that no interference occurred to existing and future FSS systems.<sup>4</sup>

As discussed below, SIA submits that Qualcomm has not provided sufficient technical information to fully assess its concept or to support initiation of a rulemaking proceeding at this time. SIA provides comments on the various shortcomings of the technical data and interference

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Segovia, Inc.; Spacecom, Ltd.; Spacenet Inc.; Stratos Global Corporation; TeleCommunication Systems, Inc.; Telesat Canada; Trace Systems, Inc.; Ultisat, Inc.; and ViaSat, Inc. Additional information about SIA can be found at [www.sia.org](http://www.sia.org).

<sup>3</sup> See Qualcomm, “Petition for Rulemaking in the Matter of Amendment of the Commission’s Rules to Establish a Next-Generation Air-Ground Communications Service on a Secondary Licensed Basis in the 14.0–14.5 GHz Band,” RM-11640 (filed July 7, 2011) (“Petition”).

<sup>4</sup> See *May 15<sup>th</sup> Public Notice* at 2.

analyses submitted to date, and provides additional policy reasons why a rulemaking on Qualcomm's proposed Ku-band ATG concept is not warranted at this time.<sup>5</sup>

## **I. SUFFICIENCY OF QUALCOMM'S TECHNICAL MATERIAL**

There are serious omissions and flaws in the technical material provided by Qualcomm that make it impossible for SIA or interested parties to adequately assess the potential interference into incumbent FSS systems from proposed ATG operations. Qualcomm's interference analysis appears to be based on faulty assumptions that do not support the conclusions reached. In addition, the antenna data Qualcomm has provided is either insufficient or inconsistent.

### **A. Technical Data Submitted to Date Does Not Support Initiation of a Rulemaking**

While substantial technical work has been conducted by Qualcomm in support of its proposed Ku-band ATG concept, there remain numerous deficiencies in the technical materials submitted by Qualcomm. A proposed new entrant to an occupied frequency band must demonstrate that its contemplated operations can effectively share the band with incumbent services and licensees. As outlined below, the technical information submitted by Qualcomm contains inconsistencies, omissions, faulty assumptions and unsupported conclusions. Consequently, Qualcomm has not successfully demonstrated that a secondary Ku-band ATG system can operate in the 14.0–14.5 GHz band.

Even if the Commission were to conclude that there is sufficient technical information to initiate a rulemaking, SIA reiterates its concern that moving forward on the basis proposed by

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<sup>5</sup> SIA previously submitted initial comments regarding the Petition on September 29, 2011. *See* Comments of the Satellite Industry Association, Amendment of the Commission's Rules to Establish a Next-Generation Air-Ground Communications Service on a Secondary Licensed Basis in the 14.0 to 14.5 GHz Band, RM-11640 (filed Sept. 29, 2011) ("SIA Comments").

Qualcomm would effectively “lock in” all potential ATG providers to the Qualcomm concept. Qualcomm’s ATG concept is based on a proprietary system architecture and complex (although not fully developed) technical characteristics. No other provider -- even if there were one -- could effectively construct a competing system using an alternative architecture if Qualcomm’s proposal is adopted. The Commission should therefore be cautious in moving forward with any proposal that effectively establishes one technology or technical solution as the *de facto* standard rather than allowing market competition and innovation to drive technical implementation. This is particularly true in circumstances where, as here, it is unclear how the new service can practically share, on a secondary basis, with the extensive primary FSS operations in the same band.

**B. Qualcomm’s Interference Analysis Is Based on Faulty Assumptions and Suspect Conclusions**

In its Petition, Qualcomm provided its analysis pertaining to the predicted interference to GSO FSS space stations from the transmissions of its aircraft and ground stations. For a number of the interference cases that it studied, Qualcomm relied upon assumptions or estimates for which it offered no supporting evidence. Consequently, any conclusions to be drawn from these studies are highly suspect. The following sections describe more fully several of these faulty assumptions.

**1. Protection of GSO FSS Operations**

Qualcomm uses the FSS protection criteria contained in Recommendation ITU-R S.1432 to show that its proposed system would not result in harmful interference to GSO FSS space stations. Qualcomm asserts that GSO FSS satellites would be protected from interference if the



resultant increase in the noise temperature due to the additional interference from a proposed ATG service would not exceed 1% Rise over Thermal (“RoT”) threshold.<sup>6</sup>

Qualcomm’s submissions suggest that its ATG concept would take approximately two-thirds of the 1% in FSS link budgets reserved for non-primary services under ITU-R S.1432.<sup>7</sup> However, Recommendation ITU-R S.1432 provides that aggregate interference from all non-primary sources should account for no more than 1% RoT of the FSS link budget.<sup>8</sup> Combined with other non-primary services in the Ku-band (which include the mobile-satellite and space research services),<sup>9</sup> the proposed secondary ATG operations may well violate the permissible RoT threshold.<sup>10</sup>

Even if there were no other interference contributions from other secondary sources, it is not at all clear that Qualcomm’s calculations are accurate. For example, Qualcomm assumes a fixed EIRP and front-to-back ratio in its calculation even though the ATG ground station antenna beam will track aircraft in flight. In addition, Qualcomm acknowledges that a mature ATG system could have 250 base stations with 1000 beams rather than the 150 base stations with 600 beams used in the calculation. Thus, if this calculation were to be extrapolated, interference from ATG operations alone may exceed the available 1% RoT.

Given the other non-primary services in the 14.0–14.5 GHz band, the Commission should find that only a small fraction of the RoT may be attributable to a secondary Ku-band ATG

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<sup>6</sup> Petition at 21, Appendix A-11, A-42.

<sup>7</sup> *Id.* at Appendix A-15 - A-18.

<sup>8</sup> *See* SIA Comments at 7.

<sup>9</sup> 47 C.F.R. § 2.106.

<sup>10</sup> It should also be noted that many satellites that serve the United States also serve areas outside the country (*e.g.*, Canada, Mexico and the Caribbean). As a result, interference to receiving GSO FSS space stations could come from secondary operations in these areas as well.

system, and that Qualcomm's proposed operations are likely to exceed that threshold. Due to the lack of antenna gain information and the difficulty in understanding the procedure used to determine the gain of the aircraft antenna toward the GSO arc, the veracity of Qualcomm's computations regarding RoT cannot be sufficiently assessed. As a result, Qualcomm's fundamental claim that GSO FSS space stations will not receive interference from ATG transmissions has not been adequately substantiated.

## **2. Interference From FSS into Ku-band ATG Operations**

Of equal concern to FSS operators is the ability of Qualcomm's proposed Ku-band ATG service to practically withstand interference from FSS applications in the 14.0–14.5 GHz band, including large fixed earth stations, VSATs and various mobile and temporary fixed applications. This concern arises from, among other issues, the proposal that ATG licensees would be obtained via auction. ATG operators that paid for licenses and deployed expensive ground infrastructure would expect full access to the spectrum even though the proposed ATG service would have only secondary status. The differences in technical characteristics and regulatory status between ATG and FSS operations pose a grave threat to both services.

### **a. Interference From FSS into Ku-band ATG Airborne Stations**

Qualcomm's technical analysis of interference from FSS into ATG airborne stations is based on a number of unsupported assumptions. Qualcomm divides the VSATs that are located within a 300 km radius of the aircraft into two groups – those that are located north of the aircraft and those that are located south of the aircraft.

With regard to the south-side VSATs, Qualcomm assumed that many VSAT installations will be fully shadowed by other buildings in direction of the receiving aircraft in estimating that only 25% of the south-side VSATs have an unobstructed view of the aircraft. These assumptions are highly subjective and Qualcomm has provided no evidence to support its assumptions. In

fact, there are large numbers of VSATs that are mounted on roofs of buildings in urban, suburban and rural areas that would have unobstructed views of aircraft at altitude since they must have an unobstructed view of the sky.

With respect to north-side VSATs, Qualcomm's calculation of interference is unclear. The description suggests a Monte Carlo simulation that cumulates VSAT and aircraft antenna gain roll-off, but Qualcomm then also subtracts another 15 dB of front-to-back ratio. It is not clear that this additional subtraction is correct given the Monte Carlo simulation approach. Without this additional 15 dB of attenuation, the interference situation would be significantly worse than suggested.

In addition, Qualcomm assumed that 50% of the GSO FSS space stations operating in the 14.0–14.5 GHz band carry VSAT traffic and assumed that the relevant number of VSATs operating within the contiguous United States (“CONUS”) is 5500. However, Qualcomm provided no factual evidence in support of its estimate. In fact, as SIA indicated in its earlier comments, there are over 600,000 VSAT terminals operating in the United States.<sup>11</sup> Assuming that the distribution of these VSATs in frequency within the 14.0–14.5 GHz band is uniform, then within a 50 MHz segment, the number of operating VSATs is 60,000 VSATs ((50 MHz / 500 MHz) \* 600,000 VSATs). Accordingly, the carrier-to-VSAT interference (“ $C/I_{VSAT}$ ”) ratio at the receiving Ku-band ATG aircraft, as calculated in Table A.15 of Qualcomm's Petition should be modified to show a value of 6.9 dB.

With a  $C/I_{VSAT}$  of 6.9 dB, the forward link carrier-to-noise-plus-interference (“ $C/(N+I)$ ”) ratio would be reduced from 10.21 dB to 5.2 dB, which is only 1.2 dB higher than the minimum  $C/(N+I)$  of 4 dB required by the Ku-band ATG forward link. If the aircraft is flying over an area

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<sup>11</sup> SIA Comments at 3.

where the VSAT deployment density is two times higher due to non-uniformity of VSAT distribution across the CONUS, the  $C/I_{VSAT}$  would be reduced to 3.9 dB with the forward link  $C/(N+I)$  falling to 2.9 dB, which is less than the required level of 4 dB (*i.e.*, the forward link would be disrupted).

The situation only worsens if Qualcomm were to reduce power in order to accommodate a larger, 1000-beam deployment. In its January 30, 2012 letter to the FCC's International Bureau, Qualcomm stated,

According to Qualcomm's design, the hard limit on the number of beams would be 1000 beams. However, as discussed in response to Question 1 above, as the number of sites is increased over time, the transmit EIRP from the GSs and the aircraft would be decreased by the same amount so that the total EIRP from all sites/aircraft will be equivalent to that for the 600-beam example described in detail in Appendix A of the Petition.<sup>12</sup>

Assuming that the Ku-band ATG system grows to the 1000 ground-to-air beam configuration, the forward link EIRP would be reduced from 39.5 dBW to 37.3 dBW ( $39.5 \text{ dBW} - 10\text{Log}(1000/600)$ ). With this lower EIRP value, the link  $C/N$  is reduced from 10.2 dB to 8 dB; and  $C/I_{VSAT}$  decreases from 6.9 dB to 4.7 dB, assuming a uniform distribution of VSATs within CONUS. This results in the  $C/(N+I)$  being reduced from 5.2 dB to 3 dB, which is less than the minimum required  $C/N$  of 4 dB, and the link would be completely disrupted. For the case where the deployment density of VSATs is twice that of uniform deployment, the  $C/(N+I)$  of the link is reduced from 3 dB to 0 dB, *i.e.* the link is disrupted.

#### **b. Interference From FSS into Ku-band ATG Ground stations**

As a primary service, FSS earth stations would have unfettered access to the 14.0–14.5 GHz band vis-à-vis ATG operations. Existing and future earth station transmit operations,

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<sup>12</sup> Letter from Dean R. Brenner, Vice President, Qualcomm, to James Ball, Chief, Policy Division, International Bureau, Federal Communications Commission, RM-11640, Attachment at 2 (filed Jan. 30, 2012) (“Qualcomm January 2012 Letter”).

including ever-growing VSAT deployment and Ku-band mobile broadband services, pose a real interference problem into ATG ground stations. From the air-to-ground link budget contained in Table A.2 of the Qualcomm Petition, it appears that FSS earth station transmissions resulting in a carrier-to-interference (“C/I”) ratio of 5.8 dB would disrupt an ATG link by causing the link’s carrier-to-noise ratio to be at the minimum required level of 4.0 dB.

The table below assumes that (i) the transmitting FSS earth station antenna gain towards the receiving ATG ground station is -10 dBi; (ii) the transmitting FSS earth station operates with a maximum power density level of -50 dBW/Hz (as specified in Section 25.212 of the FCC rules for routine processing); and (iii) the transmitting FSS Earth station is located within the main-lobe or the 3 dB beam-width of the receiving ATG ground antenna. Based on these assumptions, the required free space distance separation between these stations (without accounting for curvature of the Earth) would be 826.6 km (for an earth station located within the main lobe of the ATG antenna), and 585.2 km (for an earth station located at the half-power beam-width angle of the ATG antenna). These free space models calculations may be overly conservative, although there will be cases where there is limited terrain or other blockage between rooftop VSATs or larger earth stations and victim ATG antennas. Modified versions of the free space loss formula using coefficients of 2.5 and 3 (instead of 2) result in separation distances of 15.1 km/11.5 km and 1.1 km/.8 km, respectively.

|  |        |        |
|--|--------|--------|
| ATG Receiving Ground Station Antenna Off-Axis Angle (deg)                              | 0.0    | 1.0    |
| ATG Receiving Ground Station Maximum Gain (dBi)  | 37.0   | 37.0   |
| ATG Receiving Ground Station Antenna Off-Axis Gain (dBi)                               | 37.0   | 34.0   |
| Plane EIRP Toward ATG Receiving Ground Station (dBW)                                   | 3.0    | 3.0    |
| Atmospheric Loss (dB)  | 3.0    | 3.0    |
| Path Distance (km)   | 300.0  | 300.0  |
| Path Loss (dB)   | 164.9  | 164.9  |
| Frequency (GHz)  | 14.0   | 14.0   |
| Wavelength (m)   | 0.0214 | 0.0214 |
| ATG Carrier Bandwidth (MHz)  | 2.0    | 2.0    |
| ATG Received Power (dBW)   | -127.9 | -127.9 |
| FSS Uplink Power Density (dBW/Hz)  | -50.0  | -50.0  |
| FSS Uplink Earth Station Off-Axis Gain (dBi)   | -10.0  | -10.0  |
| FSS Uplink Earth Station Off-Axis EIRP Density (dBW/Hz)                                | -60.0  | -60.0  |
| FSS EIRP Towards ATG Receive Ground Station Antenna (dBW)                              | 3.0    | 3.0    |
| C/I Required At the ATG Receiving Ground Station To Cause Interference (dB)            | 5.8    | 5.8    |
| Max. Power That Can Be Received By ATG Ground Receiving System (dBW)                   | -133.7 | -133.7 |
| Max. Path Loss Between Transmitting FSS and Receiving ATG Station (dB)                 | 173.7  | 170.7  |
| Minimum Separation Required Based Upon Free Space Loss $(4\pi r/\lambda)^2$ (km)       | 826.6  | 585.2  |
| Minimum Separation Required Based Upon Path Loss Formula $(4\pi r/\lambda)^{2.5}$ (km) | 15.1   | 11.5   |
| Minimum Separation Required Based Upon Path Loss Formula $(4\pi r/\lambda)^3$ (km)     | 1.1    | 0.8    |

The calculation of required separation distances is necessarily speculative because of the limited technical information available to SIA regarding the ATG ground station antennas.<sup>13</sup> Importantly, however, there can be no guarantee that existing or future FSS earth station deployment would be any specified distance from an ATG ground station. Thus, the potential for disruptive and repeated interference into the ATG system is quite real.

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<sup>13</sup> See Section I.C., below.

### **3. Interference Between ATG and Ku-Band NGSO FSS Systems**

The Commission has allocated the Ku-band for co-frequency to NGSO FSS services.<sup>14</sup> Although no NGSO FSS systems have been deployed to date, Ku-band licensing is conditioned upon coordination with NGSO FSS systems. Secondary services in the Ku-band must be designed and deployed to accept potential interference from future NGSO FSS systems. These secondary services, including mobile VSATs, are driving consumer demand that may well support such NGSO FSS systems.

Because of the limited technical information provided, it is difficult to assess Qualcomm's claims of non-interference between ATG and future NGSO FSS operations. SIA would note, however, that different NGSO system designs than those assumed by Qualcomm could result in substantially different conclusions with respect to ATG interference into NGSO FSS space station receivers. In addition, NGSO FSS earth stations with tracking antennas could significantly disrupt ATG aircraft station and ground station receive operations.

#### **C. Basic Antenna Data**

Although Qualcomm has provided general information regarding its proposed Ku-band ATG concept, the information regarding the antennas that make up its system is either insufficient or inconsistent. For instance, Qualcomm has not provided the transmit or receive antenna pattern of its phased array ground station antenna or its blade type aircraft antenna, which makes it difficult to properly assess the interference impact of Qualcomm's proposed system, and the ability of that system to withstand interference from the primary FSS.

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<sup>14</sup> *Amendment of Parts 2 and 5 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*, First Report and Order and Further Notice of Proposed Rulemaking, 16 FCC Rcd 4096 (2000).

Second, the technical information Qualcomm has provided regarding the aircraft antenna is inconsistent. For example, in Section 1.1 of Appendix A of Qualcomm's Petition, it is stated that the horizontal 3 dB beam-width of the aircraft antenna is approximately 85° and the vertical beam-width is 12°. <sup>15</sup> However, later in that section, it is stated that the boresight of the antenna is directed to be 5° below horizon, with the gain roll-off at horizon being approximately 3 dB, <sup>16</sup> which seems to imply that the 3 dB beam-width in elevation is 10° not 12°.

Third, in Section 3.3.1.2 of the aforementioned Appendix, it is stated that the aircraft antenna roll-off in elevation is at least 20 dB for angles  $\geq 15^\circ$  above the horizon, <sup>17</sup> which is at odds with the information provided in Section 1.1 in the Appendix that states that the roll-off gain in elevation is 20 dB at angles of  $\geq 20^\circ$  above horizon. <sup>18</sup>

In this connection, Qualcomm has made certain assumptions about the orientation of the aircraft antenna and the resulting gain of the transmitting antenna toward the space station. However, the explanations and descriptions provided are extremely difficult to follow and one cannot ascertain whether the antenna roll-off gain assumptions used in the calculations are applicable or correct. In short, based upon the incomplete information provided by Qualcomm, SIA cannot confirm Qualcomm's calculations since it cannot confirm the veracity of its assumption on the off-axis gain of its aircraft antenna towards the GSO orbit.

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<sup>15</sup> Petition at Appendix A-5 – A-8.

<sup>16</sup> *Id.* at Appendix A-5.

<sup>17</sup> *Id.* at Appendix A-20.

<sup>18</sup> *Id.* at Appendix A-5.



## **II. IMPRACTICABILITY OF OPERATING ONE OR MORE AIR-GROUND SYSTEMS IN THE 14.0–14.5 GHZ BAND ON A SECONDARY BASIS**

As discussed above, from a technical standpoint, it would appear that Ku-band ATG aircraft and ground stations would be subject to harmful levels of interference from existing VSAT systems, not to mention interference from other non-VSAT type transmissions. Additionally, Qualcomm has provided no credible solution to interference into its ground stations from FSS earth stations that may be deployed at anytime at a nearby location. In this regard, the north-pointing ATG ground station antennas would be particularly susceptible to south-pointing FSS earth stations communicating with geostationary satellites. Moreover, as Qualcomm's ground station antenna sweeps across the northern sky, it could encounter interference from multiple FSS earth stations and VSATs installed in the vicinity. Qualcomm offers several proposed mitigation techniques to effectuate band sharing with primary FSS uplinks and future NGSO FSS uplinks, but SIA contends that these do not withstand scrutiny.

### **A. Sharing with Primary FSS Uplinks**

In its October 14, 2011 Reply Comments, Qualcomm indicated that when a mobile Ku-band earth station (such as vehicle-mounted earth stations) or transportable/temporary fixed earth station comes close to its ground station, the ATG system could, as a mitigating technique, position the null of its beam in the direction of the interfering FSS earth station.<sup>19</sup> However, Qualcomm does not indicate how it would determine the location of the temporary interfering station.

Another mitigation technique that Qualcomm has proposed to deal with interference from temporary FSS earth station transmission is to use a different frequency that is not utilized by

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<sup>19</sup> Qualcomm Reply Comments, RM-11640, Appendix A Supplement at A-4 (filed Oct. 14, 2011) (“Qualcomm Reply Comments”).

that earth station.<sup>20</sup> However, Qualcomm does not describe how it would dynamically account for variations in frequency usage by mobile, transportable and temporary fixed VSAT operations. This would be an issue for fixed VSAT and larger FSS earth stations as well.

Further, in its Reply Comments, Qualcomm indicated that it would be amenable to shutting down the affected ground station and letting the traffic load be picked up by another (presumably) adjacent cell.<sup>21</sup> However, this solution, although a requirement for a secondary allocated service, does not seem practical or feasible given the growing numbers of mobile and temporary fixed earth stations that operate in the United States. Hence, it is unclear how many ground stations that the proposed Ku-band ATG system can shut down on a temporary basis and still provide a viable service. Of course, this also would not be a practical solution to address fixed FSS earth station and VSAT deployments in the vicinity of an ATG ground station.

SIA is also concerned about the practicality of Qualcomm's suggestion to relocate any one (or more) ground station(s) to another location if a permanent FSS earth station is constructed nearby and no other mitigation technique can be used. It should be noted that "permanent FSS earth stations" are not limited to major teleport sites, but also includes fixed VSAT terminals that can be installed anywhere at any time. As SIA has previously indicated, over 600,000 such VSATs are already in service today, and the number is growing. In other words, Qualcomm could be facing multiple permanent FSS earth stations near a given ATG ground station. Given that phased array ground antennas are very sophisticated pieces of hardware, and that it is not easy to identify and operate from a suitable location given the heavy usage of the 14.0–14.5 GHz band and other factors such as local zoning restrictions, it is very

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<sup>20</sup> *Id.* at 18; Appendix A Supplement at A-5.

<sup>21</sup> *Id.* at Appendix A Supplement A-5.

likely that ATG ground stations cannot be easily relocated. In view of the susceptibility of Ku-band ATG communication links to interference from FSS earth station transmissions, the cost of system implementation, and the allocation of ATG licenses by auction, ATG operators are more likely to seek relief from the Commission than to relocate multiple ground stations as FSS VSAT deployments continue to grow. The problem would only get worse as more ATG ground stations are installed.

**B. Practical Difficulties of Sharing Between Services with Significantly Different Regulatory Status and Technical Characteristics**

Band sharing between and among services is most appropriate – and achievable – where the services have similar regulatory status and technical characteristics (architecture, power levels, etc.). The Commission’s decision to allocate co-frequency NGSO FSS uplinks in the Ku-band reflects the common regulatory status and technical characteristics between it and GSO FSS uplinks.

Qualcomm’s proposed ATG system architecture appears similar to a cellular network, where the signal to the radio transceiver (a mobile phone) is passed from tower-to-tower, all transparent to the end user. Qualcomm proposes a complex “hexagonal” arrangement of 150 (or more) ground station regions to cover the CONUS.<sup>22</sup> Similar to a cellular network, the signal to the airplane will be passed from ground station to ground station as the airplane travels through the CONUS. Signals transmitted from the ground stations, however, will not be transmitted horizontally but up into the sky to support as many as 600 aircraft at the same time.<sup>23</sup> In

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<sup>22</sup> Petition at 15-16.

<sup>23</sup> *Id.* at 14.

addition, Qualcomm indicates that it would access the full 500 MHz available (either as a single channel or two channels of 250 MHz each) between 14.0–14.5 GHz.<sup>24</sup>

Additionally, once services are deployed and relied upon, it is virtually impossible to terminate or change the parameters of those services. For example, in 2005, when military land mobile communications were causing interference to consumer garage door openers, the only resolution was to encourage consumers to purchase new garage door openers.<sup>25</sup> Because interference undercuts the viability of the proposed secondary service, there is concern that, once deployed, Qualcomm would realize the extent of the problem and seek an elevation to primary status, including technical and/or operational restrictions on the FSS. Such an action might still prove ineffective in ensuring the protection of Ku-band ATG links from interference produced by more than 600,000 VSAT and other FSS earth stations that will be in service. Moreover, it would have the potential to significantly limit the future deployment of primary FSS earth stations. Such an approach is clearly not in the public interest when, as here, interference can be prevented before devices are deployed through the use of alternate spectrum.

If Qualcomm, or another ATG provider, acquires rights to offer the service in the Ku-band via an auction,<sup>26</sup> it is doubtful that it would be willing to sacrifice customer service by

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<sup>24</sup> *Id.* at 14.

<sup>25</sup> See *Public Notice*, “Consumers May Experience Interference To Their Garage Door Opener Controls Near Military Bases,” DA 05-424 (rel. Feb. 15, 2005).

<sup>26</sup> A related issue concerns the appropriateness of auctioning spectrum with only secondary status. SIA is not aware of any Commission auction that has done so. Auctions are designed to award spectrum licenses in cases of “mutual exclusivity,” that is, where a single licensee is granted exclusive rights to a particular frequency band or channels, usually within a defined geographic area. By its definition, secondary rights assume that spectrum is being shared with other users that have greater rights to that same spectrum. Qualcomm fails to explain how an ATG auction could be designed and implemented given these constraints, let alone if there is any economic incentive for a potential service provider to bid on spectrum with these limits.

accepting interference from FSS uplinks due to its secondary status. It is more likely that recourse will be sought from the Commission, including the possibility of changing the proposed secondary status for ATG into a higher regulatory status that offers interference protection from other operations in the Ku-band.

### **III. IDENTIFICATION OF THE AIR-GROUND SYSTEM AS THE SOURCE OF INTERFERENCE**

In its January 30, 2012 letter to the FCC's International Bureau, Qualcomm describes the procedure it would use to ascertain the impact of its ground station transmissions on GSO FSS space stations.<sup>27</sup> Qualcomm proposes to utilize a full transponder on a given GSO satellite for the exclusive purpose of sending test signals to the spacecraft and measuring the resulting change in the satellite's noise temperature.<sup>28</sup> Qualcomm would then extrapolate those measurements to other adjacent satellites by comparing the G/T and other parameters, which it did not identify.<sup>29</sup>

SIA does not believe that the process put forward by Qualcomm is practical. First, any interference from the proposed ATG system would appear in the form of increased noise, making it difficult to distinguish it from other forms of interference. Qualcomm indicates that the ground station received signal at the satellite is "well below" the noise floor.<sup>30</sup> Qualcomm then asserts that its measurement technique -- via a "signal to noise plus interference" measurement -- will allow the received ground station signal to be measured if there are no other satellite signals in the transponder or all other signals are small.<sup>31</sup> However, left unexplained is

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<sup>27</sup> Qualcomm January 2012 Letter at 4-5.

<sup>28</sup> *Id.* at 4.

<sup>29</sup> *Id.*

<sup>30</sup> *Id.*

<sup>31</sup> *Id.*

how the transponder will identify and isolate the ground station received signal where, as Qualcomm admits, it is “well below” the noise floor into the transponder.

Second, CONUS satellites are subject to adjacent satellite interference. Although the level of interference is controlled through coordination agreements, this interference would nevertheless be higher than the transponder’s noise and would dilute the accuracy of any measurement made by Qualcomm

Finally, Qualcomm does not address the procedure it would follow to determine if the interference into a GSO satellite is due to its ground-to-air transmissions or from its air-to-ground transmissions. Qualcomm indicates that it can track interference into a satellite transponder because its test signal contains a ground station—aircraft station specific data sequence that quickly allows it to identify the source of interference. However, it is unclear whether this sequence can actually be read if it is interfering with and supposedly also being interfered by the satellite signal.

#### **IV. REQUIRED RULES AND REGULATIONS**

As indicated in these comments, SIA believes that initiation of a rulemaking for Qualcomm’s proposed ATG service is not warranted at this time. However, in the event that the Commission elects to proceed, SIA offers the following comments. In its Petition, Qualcomm has proposed EIRP density limits for the transmission of the ground and aircraft components of its Ku-band ATG system that would purportedly protect the other primary incumbent services operating in the 14.0–14.5 GHz band. Specifically, for its ground stations, Qualcomm has proposed in the direction of the GSO orbital arc a maximum EIRP density limit for an individual ground station as well as an EIRP density limit that would be applicable to aggregate operation

of all ground stations that make up the system.<sup>32</sup> With regard to its aircraft stations, Qualcomm has also proposed in the direction of the GSO orbital arc, EIRP density limits on each aircraft station as well as an EIRP density limit on the aggregate transmissions of all aircraft stations that make up the Ku-band ATG systems.<sup>33</sup> The individual aircraft EIRP density limit is to be computed from an equation that is dependent on the number of ground stations and elevation angle and assumes that the CONUS region is divided into 89 bins each having a dimension of 2.5° in latitude and 5° in longitude.<sup>34</sup> Lastly, Qualcomm has proposed out-of-band emission limits.<sup>35</sup>

If the Commission were to decide to include a new, secondary ATG service in the 14.0–14.5 GHz band, it should specify individual and aggregate limits for the ground and aircraft component. The Commission should specify maximum EIRP density limits in the direction of the GSO arc that is applicable to each ground station, and a separate maximum EIRP density limit that is applicable to each aircraft station. The EIRP density limit for the single aircraft station should be a numerical value and not dependent on calculation through an equation that requires the division of the CONUS region into bins or for the operator to determine the average off-axis gain of its aircraft antenna, rather it should be a simple EIRP density limit. The Commission should also specify maximum aggregate EIRP density level in the direction of the GSO arc that would be applicable to the cumulative operation of the ground stations and a

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<sup>32</sup> Petition at Appendix A-15 – A-18.

<sup>33</sup> *Id.* at Appendix A-18 – A-25.

<sup>34</sup> *Id.* at Appendix B-2.

<sup>35</sup> *Id.* at Appendix B-3 – B-4.

separate aggregate EIRP density limit that would be applicable to the cumulative operation of the aircraft stations.

In addition, SIA believes that the Commission should specify rules that pertain to the following:

- a. Off-axis gain limits for the aircraft and ground station antennas.
- b. Minimum cross-polarization isolation limits on the ground and aircraft antennas.
- c. Antenna pointing accuracy for the aircraft and ground station antennas, whereby the system would automatically cease transmission within a specific period of time after it senses that the pointing accuracy has been exceeded.<sup>36</sup>

Finally, the Commission's rules should make it clear that the ATG service, including ATG ground stations, enjoys only secondary status relative to FSS in the band, and can expect no protection from interference from FSS uplinks, either now or in the future. Qualcomm, or any other provider of the proposed ATG service, would therefore be precluded from bringing a claim of interference to the Commission from existing or future mobile, permanent or temporary FSS earth stations (including VSATs).<sup>37</sup>

## **V. A RULEMAKING ON QUALCOMM'S ATG CONCEPT IS NOT WARRANTED**

In addition to the technical omissions and uncertainties associated with the proposed ATG concept, Qualcomm has not established a need to move forward with a Commission rulemaking.

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<sup>36</sup> However, it is not clear whether a pointing accuracy requirement for both the aircraft and ground stations antennas in the proposed Qualcomm ATG concept is necessary.

<sup>37</sup> The Commission's rules clearly articulate these principles. *See* 47 C.F.R. § 2.105(c)(2): Stations of a secondary service:

(i) Shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date; [and]

(ii) Cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date[.]



**A. Qualcomm Has Not Demonstrated a Need for a New, Secondary ATG Service in the 14.0–14.5 GHz Band**

Qualcomm has not demonstrated that a new, secondary ATG service in the 14.0–14.5 GHz band is needed to meet demand for in-flight passenger connectivity. While there is demand for in-flight passenger connectivity,<sup>38</sup> Qualcomm has not shown why such demand cannot be met by terrestrial or satellite-based deployments in existing frequency allocations without the interference and sharing concerns in the 14.0–14.5 GHz band.

For example, the 14.0–14.5 GHz band itself is already being used to meet the demand for in-flight passenger connectivity using FSS satellite capacity.<sup>39</sup> The Commission commenced a rulemaking over seven years ago to establish rules for aeronautical service via satellite using the 14.0–14.5 GHz band, and is poised to issue final rules in the near future. The introduction of

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<sup>38</sup> SIA acknowledges the earlier comments filed by three major airlines, United Airlines, American Airlines and Virgin American Airlines, all supporting Qualcomm’s ATG proposal. United Airlines Comments, RM-11640 (filed Sept. 29, 2011); American Airlines Comments, RM-11640 (filed Sept. 29, 2011); Virgin America Airlines Comments, RM-11640 (filed Sept. 29, 2011). However, none of the airlines made any statement that existing and future demand for onboard connectivity cannot be met without the proposed ATG service.

<sup>39</sup> *Panasonic Avionics Corporation Application for Authority to Operate Up to 50 Technically Identical Aeronautical Mobile-Satellite Service Aircraft Earth Stations in the 14.0-14.4 GHz and 11.7-12.2 GHz Frequency Bands, Order and Authorization*, DA 11-1480 (2011) (Call Sign E100089, File No. SES-LIC-20100805-00992); *See Row 44, Inc. Application for Authority to Operate Up to 1,000 Technically Identical Aeronautical Mobile Satellite Service Transmit/Receive Earth Stations Aboard Commercial and Private Aircraft, Order and Authorization*, DA 09-1752 (2009) (Call Sign E080100, File No. SES-LIC-20080508-00570); *ViaSat Inc., Application for Blanket Authority for Operation of Up to 1,000 Technically Identical Ku-Band Aircraft Earth Stations in the United States and Over Territorial Waters, Order and Authorization*, DA 07-4674 (2007) (Call Sign E050318, File No. SES-LIC-20051028-01494); *ARINC Incorporated, Application for Blanket Authority for Operation of up to One Thousand Technically Identical Ku-Band Transmit/Receive Airborne Mobile Stations Aboard Aircraft Operating in the United States and Adjacent Waters, Order and Authorization*, DA 05-1016 (2005) (Call Sign E030205, File No. SES-LIC-20030910-01261); and *The Boeing Company Application for Blanket Authority To Operate up to Eight Hundred Technically Identical Receive-Only Mobile Earth Stations Aboard Aircraft in the 11.7-12.2 GHz Frequency Band, Order and Authorization*, DA 01-658 (2001) (Call Sign E000723, File No. SES-LIC-20001204-02300).

another secondary ATG service in the same band, as suggested by Qualcomm, may well “spoil” the band for both services (given the impracticalities of sharing) and result in less robust competition in the provision in-flight passenger connectivity than would otherwise be the case.

The allocation of spectrum for new services should not be driven by an “if you build it, they will come” approach. This is particularly true where, as here, technical incompatibility and disparate regulatory status threaten many existing, primary operations. In this instance, Qualcomm has not demonstrated that a new secondary ATG allocation in the 14.0–14.5 GHz band is needed to meet demand for in-flight passenger connectivity.

For all of these reasons, SIA believes that the initiation of a rulemaking proceeding on Qualcomm’s ATG service is not warranted at this time.

**B. Even a Secondary ATG Service Could Significantly Constrain Routine FSS Operations**

The 14.0–14.5 GHz band is an important FSS band that is heavily used for a variety of satellite operations and services, including satellite fleet management and mobility services such as earth stations on vessels (“ESVs”), vehicle-mounted earth stations (“VMES”) and aeronautical mobile-satellite service (“AMSS”) using FSS capacity. In addition the 14.0-14.5 GHz band is already encumbered by the need to coordinate multiple dissimilar services (FSS, radio astronomy and space research).

Qualcomm proposes to enter into coordination agreements with the National Science Foundation to protect radio astronomy operations and sites, similar in form to coordination agreements involving AMSS.<sup>40</sup> Comments from National Radio Astronomy Observatory, however, suggest that achieving effective coordination between ATG and radio astronomy would

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<sup>40</sup> Petition at Appendix A-13, n.53.

be more difficult than with AMSS operators.<sup>41</sup> According to this commenter, ATG operations would involve downlink transmissions, which mean that the interfering signal would likely be stronger from ATG than from AMSS. Moreover, there is a higher risk of spurious emissions that may require additional coordination restrictions. ATG ground stations would need to be coordinated prior to their construction in order to minimize the potential for interference from ATG operations.

In addition, Ku-band ATG operations would need to protect NASA's Tracking and Data Relay Satellite System ("TDRSS") from interference. Qualcomm's Petition discusses the potential impact to TDRSS from both ground stations and aircraft operating its proposed ATG concept.<sup>42</sup> Because of the unique nature of TDRSS communications, the FCC requires operations in the 14.0 to 14.2 GHz band segment to protect within 125 km of existing and future TDRSS sites.<sup>43</sup> Restrictions on such a large amount of spectrum in these sizable geographic areas around TDRSS sites could prevent an operator from making effective use of the proposed lower 250 MHz channel for ATG.

In addition, there are a number of satellite activities in the 14.0–14.5 GHz band that are routinely authorized on a non-interference basis, such as launch-and-early-orbit-phase operations, satellite relocation drifts, and in-orbit testing. Avoiding interference to other satellites when these activities are performed is fairly routine, but protection of Qualcomm's

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<sup>41</sup> See Comments of the National Radio Astronomy Observatory (Charlottesville, VA), International Bureau Seeks Further Comment on Qualcomm Petition for Rulemaking, RM-11640, 2 (filed May 28, 2012).

<sup>42</sup> Petition at Appendix A-37 – A-41.

<sup>43</sup> See 47 C.F.R. § 25.222(c) (regarding ESV), 47 C.F.R. § 25.226(c) (regarding VMES).

secondary ATG service would not be. The conduct of these satellite activities in a way that avoids interference into ATG ground stations or terminals could be difficult.

This discussion illustrates how the introduction of Qualcomm's ATG service in the Ku-band, even on a secondary basis, would profoundly change the sharing environment in the band.

**C. The Commission Should First Complete the Pending Ku-Band AMSS Proceeding Before Initiating the Requested ATG Rulemaking**

At the very least, SIA urges the Commission to first complete the long-pending Ku-band AMSS proceeding prior to taking any action on the requested ATG rulemaking, which has been pending since 2005.<sup>44</sup> Currently, AMSS services are provided only on a secondary, non-interference/non-protected basis,<sup>45</sup> even though nearly identical VMES and ESV services enjoy primary status in the Ku-band. As part of the pending AMSS proceeding, the Commission has been asked to elevate Ku-band AMSS operations to co-primary status with VMES and ESV.<sup>46</sup>

Despite the current regulatory uncertainty surrounding AMSS services in the Ku-band, several companies have deployed AMSS networks and begun operating these services pursuant to Commission licenses.<sup>47</sup> Each of these AMSS providers has spent considerable time and resources in developing their proprietary systems to avoid causing or receiving interference from

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<sup>44</sup> See *Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service (AMSS)*, IB Docket No. 05-20, Notice of Proposed Rulemaking, 20 FCC Rcd 2906 (2005).

<sup>45</sup> See 47 C.F.R. § 5.111(a)(2).

<sup>46</sup> See Letter from Bruce A. Olcott and Joshua Guyan, Counsel to The Boeing Company, to Mindel De La Torre, Chief, International Bureau, FCC, IB Docket No. 5-20 (filed Apr. 20, 2010); see also The Boeing Company, Petition for Reconsideration, IB Docket No. 07-101 (filed Dec. 4, 2009).

<sup>47</sup> In addition, just last month GoGo LLC filed an application with the Commission for a license for a new AMSS service on both domestic and international commercial flights. See GoGo LLC, Application for Blanket Authority for Operation of 1000 Technically Identical Ku-Band Transit/Receive Earth Stations in the Aeronautical Mobile Satellite Service, File No. SES-LIC-INTR2012-01528 (filed June 18, 2012).

primary FSS transmissions in the Ku-band. None of these AMSS services took into the account the potential need to share spectrum with secondary ATG operations. Introduction of a secondary ATG service could lead to significant priority issues and coordination burdens for Ku-band AMSS.

Accordingly, SIA urges the Commission to first conclude the pending AMSS proceeding, including the request to provide co-primary status to these services, so that these satellite-based aeronautical services can be deployed on a secure footing. Only then, should the Commission consider whether the introduction of Qualcomm's ATG service is warranted in this heavily used satellite band.

## **VI. CONCLUSION**


SIA respectfully submits that Qualcomm has not demonstrated in its Petition that the 14.0–14.5 GHz band is suitable for a secondary Ku-band ATG service or that its proposed concept can withstand or practicably avoid interference from incumbent primary operations in the Ku-band, including various FSS uplink transmissions. Qualcomm also has not provided sufficient technical information about its system or its analysis for SIA to confirm the impact of the Ku-band ATG system on incumbent primary services.

Even a secondary ATG service is likely to impose constraints on primary FSS services, including aeronautical services provided via satellite that would otherwise meet the demand for in-flight connectivity that Qualcomm identifies. In addition, introduction of an ATG service in the Ku-band would further complicate a complex sharing scenario with other services, including radio astronomy and space research. At a minimum, SIA urges the Commission to conclude the pending AMSS proceeding before taking any action regarding a rulemaking for the proposed ATG service.

For these reasons, there is insufficient basis for the Commission to proceed with a rulemaking concerning the allocation of a secondary mobile service in the 14.0–14.5 GHz band.

Respectfully submitted,

The Satellite Industry Association

By:   
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Patricia Cooper  
President

## **CERTIFICATE OF SERVICE**

I, Mark D. Johnson, do hereby certify that on this 16th day of July, 2012, I caused to be sent via First Class, postage prepaid US mail, a copy of the foregoing, "Comments of the Satellite Industry Association," dated this same date, to the following persons:

Dean R. Brenner  
Vice President, Government Affairs

John W. Kuzin  
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/s/ Mark D. Johnson  
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