Before the
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C.

In the Matter of	)	
	)	
Application of Motorola Global Communications, Inc. For Authority to Launch and Operate the Celestri Multimedia LEO System, a Global Non-Geostationary Orbit Satellite System in the Fixed-Satellite Service	)	File No. 79-SAT-P/LA-97

REPLY COMMENTS OF
LOCKHEED MARTIN CORPORATION

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SUMMARY

Lockheed Martin Corporation ("Lockheed Martin") hereby submits its reply comments on the application of Motorola Global Communications, Inc. ("Motorola") for the Celestri Multimedia LEO System ("Celestri LEO"). Lockheed Martin is the licensee of the Astrolink™ System, a GSO FSS system which will provide advanced broadband communications services in the Ka-band. Recently, Lockheed Martin submitted applications covering: 1) a minor amendment to the Astrolink™ GSO FSS authorization; 2) a follow-on Ka-band GSO FSS system (Astrolink-Phase II™); and 3) a Ka-band MEO FSS system (LM-MEO System). While Lockheed Martin has a strong interest in the development and deployment of new satellite technologies, these applications are a further demonstration of Lockheed Martin's serious commitment to ensuring that GSO FSS systems can operate on an interference-free basis with NGSO FSS systems in the primary GSO FSS Ka-band frequencies.

Motorola requests authority to operate its proposed 63-satellite Ka-band NGSO FSS system in, *inter alia*, the 19.7-20.2 GHz and 29.5-30.0 GHz bands, which are designated for GSO FSS use on a primary basis and for NGSO FSS use on a secondary basis.[1] In its application, Motorola clearly states that it is not requesting protection from interference caused by, and will not cause unacceptable interference to, any existing or future GSO FSS system licensed to operate in the 19.7-20.2 GHz and 29.5-30.0 GHz primary GSO FSS bands. However, as other

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[1] *See generally Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed-Satellite Services*, First Report and Order and Fourth Notice of Proposed Rulemaking, CC Docket No. 92-297 (rel. July 22, 1996) ("*28 GHz Order*").

commenters/petitioners have noted, Motorola has not yet demonstrated that the Celestri LEO System can operate without causing such interference into GSO FSS systems: the proposed mitigation techniques, as set forth in the Celestri LEO application, do not prevent unacceptable interference into GSO FSS systems in either the uplink or downlink directions. Accordingly, Lockheed Martin agrees with those commenters/petitioners that argue that the Commission must (i) find that the sharing analyses submitted in connection with the Celestri LEO application do not demonstrate the system's ability to operate on a non-interference basis with GSO FSS systems, and, as further elaborated herein, (ii) seek revised analyses from Motorola which accurately reflect the sharing scenario in the subject bands before acting upon its application.

Furthermore, Motorola correctly asserts that without its use of mitigation techniques, such as satellite diversity and beam management, GSO FSS operations authorized on a primary basis would suffer unacceptable interference, rendering secondary operations by the Celestri LEO System impossible. However, as commenters/petitioners have noted, any NGSO FSS systems proposing to operate on a secondary basis are unable to claim protection from, or cause harmful interference to, GSO FSS operations with licensing priority. In fact, consistent with the Commission's 28 GHz Order and the Ka-band service rules, any authorization of NGSO FSS operations in the primary GSO FSS frequencies should be clearly conditioned upon operation on only an unprotected non-interfering basis.

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REPLY COMMENTS OF
LOCKHEED MARTIN CORPORATION

Lockheed Martin Corporation ("Lockheed Martin") hereby submits its reply comments in connection with the comments, petitions to defer, and other pleadings that were filed in response to the above-captioned application of Motorola Global Communications, Inc. ("Motorola") for the Celestri Multimedia LEO System ("Celestri LEO").[2] Lockheed Martin is the licensee of Astrolink™, a global GSO FSS broadband system authorized to operate in primary GSO FSS Ka-band frequencies. On December 22, 1997, Lockheed Martin filed applications for 1) a minor amendment to the Astrolink™ GSO FSS authorization; 2) a follow-on Ka-band GSO FSS system (Astrolink-Phase II™); and 3) a Ka-band MEO FSS system (LM-MEO System), that would

[2] *See Application of Motorola Global Communications, Inc. For Authority to Construct, Launch and Operate the Celestri Multimedia LEO System, a Global Non-Geostationary Orbit Satellite System in the Fixed-Satellite Service*, File No. 79-SAT-P/LA-97 (filed June 13, 1997) ("*Celestri LEO Application*").

operate on some of the same frequencies that were specified in the Celestri LEO application.[3] Taken together, our existing GSO FSS Astrolink™ authorization and our more recent applications reflect Lockheed Martin's strong commitment to enabling new satellite technologies to progress. More specifically, they represent Lockheed Martin's commitment to ensuring that GSO FSS systems can operate on an interference-free basis with NGSO FSS systems in the primary GSO FSS Ka-band frequencies.

In these Reply Comments, Lockheed Martin addresses and expands upon some of the important technical issues that were joined by other commenters' and petitioners' initial filings.[4] Because Lockheed Martin's perspective on the initial comments may be somewhat distinctive, given the multiplicity of its interests in the subject frequency bands, it has decided to file these reply comments early, in order to give Motorola an opportunity to include any reply in the omnibus opposition/reply comments it now is to file on February 2, 1998.[5] Lockheed Martin would then file any appropriate rejoinder in its February 23 response.

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[3] *See* Application of Lockheed Martin Corporation to Launch and Operate the Astrolink-Phase II™ System, File No. _____ (filed December 22, 1997); and Application of Lockheed Martin Corporation to Launch and Operate the LM-MEO Satellite Communications System, File No. _____ (filed December 22, 1997).

[4] Comments/Petitions were filed by Loral Space & Communications Ltd. ("Loral"), KaStar Satellite Communications Corp. ("KaStar"), GE American Communications, Inc. ("GE Americom"), Hughes Communications Galaxy, Inc. ("Hughes"), Fixed Point-to-Point Communications Section/Telecommunications Industry Association ("TIA"), Teledesic Corporation ("Teledesic"), and the Satellite Coalition.

[5] The Commission recently extended the deadline for Motorola's reply to the initial comments and petitions to deny from January 12, 1998 to February 2, 1998. *See Report Nos. SPB-105 (DA 97-2201), et. seq.*, DA 98-21, slip op. at 2 (Satellite and Radiocommunication Division, released January 7, 1998). The response deadline was extended to February 23, 1998 in the same order. *Id.*, DA 98-21, slip op. at 2.

Motorola proposes to launch and operate its system of 63 non-geostationary satellite orbit ("NGSO") space stations to provide fixed-satellite services ("FSS") in the Ka-band. Specifically, Motorola seeks to operate Celestri LEO service, gateway, and TT&C links in the 18.8-19.3 GHz and 19.7-20.2 GHz bands (space-to-Earth), and in the 28.6-29.1 GHz and 29.5-30.0 GHz bands (Earth-to-space).

The spectrum requested by Motorola includes the 19.7-20.2 GHz and 29.5-30.0 GHz bands, which have been designated by the Commission for GSO FSS operations on a primary basis. According to the Commission's 28 GHz band-plan and Ka-band service rules, NGSO FSS systems are to be authorized to operate in these bands on a secondary basis only, subject to a technical demonstration to that effect; therefore, they must protect GSO FSS systems from harmful interference, and they may not claim protection from GSO FSS systems. Importantly, Motorola states that it is not requesting protection from interference caused by, and will not cause unacceptable interference to, any existing or future GSO FSS systems licensed to operate in the 19.7-20.2 GHz and 29.5-30.0 GHz bands. However, we agree with those commenters/petitioners that point out that Motorola's application, as amended, does not demonstrate that the Celestri LEO System can operate on a non-interference basis *vis-à-vis* GSO FSS systems in the primary GSO FSS Ka-band frequencies.

Accordingly, Lockheed Martin urges the Commission to find that Motorola's current technical submission for the Celestri LEO System, as described, does not demonstrate that the system can operate co-frequency on a secondary basis with GSO FSS systems. Lockheed Martin agrees with GE Americom that, prior to acting upon the application, the Commission should require Motorola to demonstrate adequately that it can operate its NGSO FSS system without causing harmful interference to primary GSO FSS operations in these bands.

I. BACKGROUND

Earlier this year, the Commission issued authorizations for one NGSO FSS and 13 GSO FSS satellite systems to operate in Ka-band frequencies, including Lockheed Martin's Astrolink™ System.[6] The Astrolink™ System, along with the other US-licensed Ka-band satellite systems, reflect a commitment of upwards of $30 billion to advanced broadband satellite communications. Successful deployment and operation of these new satellite networks requires certainty as to protection from harmful interference from other authorized services without licensing priority in the various segments of the primary FSS spectrum. The Commission's 28 GHz band-plan, and the associated Ka-band service rules, are designed to ensure that these next-generation satellite systems can operate on an interference-free basis where they enjoy licensing priority.

The 28 GHz band-plan was devised after lengthy FCC proceedings and reflects a compromise solution to accommodate the spectrum needs of four competing sectors — GSO FSS systems, NGSO FSS systems, NGSO Mobile Satellite Service ("MSS") feeder links, and Local Multipoint Distribution Service ("LMDS").[7] The 28 GHz band-plan balances the requirements of these various services to achieve an efficient and equitable allocation of Ka-band spectrum through a combination of band segmentation and sharing. The segmentation and

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[6] *See* FCC News, International Bureau Grant Licenses for 73 New Ka-Band Satellites, IN 97-12 (May 9, 1997); *see also Teledesic Corporation Application for Authority to Construct, Launch, and Operate a Low Earth Orbit Satellite System in the Domestic and International Fixed Satellite Service*, Order and Authorization, File Nos. 22-DSS-P/LA-94, 43-SAT-AMEND-95, 127 SAT-AMEND-95 (rel. Mar. 14, 1997).

[7] *See generally 28 GHz Order.*

sharing regime embodied in the 28 GHz band-plan was derived after careful analysis concerning the technical and operational characteristics of the respective Ka-band services.

A key element of the Commission's 28 GHz band-plan is the designation of "primary" and "secondary" services within individual band segments. For example, in the 19.7-20.2 GHz downlink band, GSO FSS is the primary designated service and NGSO FSS is secondary only. Conversely, in the 28.6-29.1 GHz uplink band, NGSO FSS is primary and GSO FSS has a secondary designation.[8] However, as advances in satellite technology continue to evolve, it is believed that this band-plan will facilitate increasingly efficient use of this spectrum, while respecting and maintaining the underlying rationale for the band segmentation and sharing regimes.

The primary and secondary designations in the 28 GHz band-plan reflect a careful balancing of technical difficulties, spectral efficiencies, and other considerations applicable to satellite operations in the Ka-band.[9] A primary designation ensures that the satellite service with licensing priority will be able to fully utilize its assigned spectrum without operational constraints or interference from a secondary service. A secondary designation permits a satellite service to utilize additional spectrum if, and only if, the secondary service can operate without causing harmful interference to the satellite service with licensing priority; the secondary service

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[8] Although the designation of primary GSO FSS and NGSO FSS spectrum in separate band segments reflects the conclusion that GSO FSS and NGSO FSS systems could not operate co-frequency without severe operational constraints on both services, new advancements in satellite technologies strongly suggest that NGSO operations on a non-interference basis are feasible using appropriate mitigation techniques.

[9] Of course, where sharing between services was demonstrated as technically feasible, the Commission included co-primary designations in the band plan. For example, GSO FSS and NGSO MSS feeder links are co-primary in the 29.25-29.5 GHz frequency band.

also may not claim protection from interference caused by the satellite service with licensing priority.

The Commission's recently-issued Ka-band service rules preserve this important distinction between primary and secondary licensing priorities.[10] Indeed, the service rules strictly enforce the 28 GHz band plan's primary and secondary designations by requiring:

> any service provider proposing to operate in a band segment in which it does not have licensing priority to operate on an unprotected non-interference basis to the priority service.[11]

To ensure non-interfering operations, the Ka-band service rules also require:

> all secondary operators to submit to the Commission a technical demonstration that it can operate on a non-harmful interference basis to the type of satellite system with licensing priority.[12]

In reviewing the Celestri LEO application, Lockheed Martin agrees generally with those commenters/petitioners that urge the Commission to remain mindful of the important distinction between primary and secondary licensing priorities, and to give this distinction full effect through enforcement of the requirements in the 28 GHz band plan and Ka-band service rules applicable to the secondary operation of NGSO FSS systems. For reasons detailed below, Motorola's technical submission does not demonstrate that the Celestri LEO System can operate on a non-interference basis with GSO FSS systems in the primary GSO FSS frequency bands.

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[10] *See Rulemaking to Amend Parts 1, 2, 21 and 25 of the Commission's Rule to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*, Third Report and Order, CC Docket No. 92-297 (rel. Oct. 15, 1997) ("*Ka-Band Service Rules*").

[11] *See id.* ¶ 39.

[12] *Id.*

II. MOTOROLA HAS NOT DEMONSTRATED THAT THE CELESTRI LEO SYSTEM CAN OPERATE ON AN UNPROTECTED NON-INTERFERENCE BASIS IN PRIMARY GSO FSS FREQUENCY BANDS

In the Celestri LEO application, Motorola correctly points out that without using satellite diversity and beam management techniques in primary GSO FSS bands (19.7-20.2 GHz and 29.5-30.0 GHz),[14] the level of interference into primary GSO FSS systems would be unacceptable, rendering secondary operations by the Celestri LEO System impossible.[15] However, a close examination of the Celestri LEO application reveals that Motorola has not demonstrated that its system can effectively mitigate interference in either the uplink or downlink direction using the techniques described.[16] Moreover, it is not entirely clear that the Celestri LEO System design is able to utilize satellite diversity for earth stations located in all geographic areas of the world that Motorola intends to serve.

A. The Celestri LEO System Will Cause Unacceptable Uplink Interference Into Primary GSO FSS Systems

Motorola correctly contends that uplink interference can be controlled by ensuring that Celestri LEO earth stations avoid transmitting when pointed within a certain angle of the GSO arc. Specifically, Motorola suggests that a 4° avoidance angle is sufficient for its satellite

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[14] *See Celestri LEO Application* at 69-70, App. B; *see also* Celestri Multimedia LEO System Frequency Sharing With Geostationary Constellations Using Satellite Diversity and Beam Management (Aug. 7, 1997) ("*Celestri Sharing Study*").

[15] *See, e.g., Celestri LEO Application* at 69.

[16] *See, e.g., Loral Comments* at 11.

diversity scheme to be effective. However, other portions of Motorola's application show that a 4° avoidance angle may not effectively prevent uplink interference into GSO FSS systems.

Although Motorola suggests that a 4° avoidance arc would reduce uplink interference by at least 27.5 dB, this claim is inconsistent with information provided by Motorola for the Celestri LEO transmit earth station off-axis gain characteristics.[17] In the Celestri LEO application, Motorola states that the Celestri LEO System "ground station antenna pattern" will comply with ITU Appendix S8.[18] At an off-axis angle of 4°, Appendix S8 gives an antenna gain of 22.2 dBi, which is only 13.4 dB below the stated peak gain of 35.6 dBi for the Celestri LEO earth station antenna.[19] Motorola has provided no indication of how an additional interference reduction of 14.1 dB will be achieved. Clearly, a mask more stringent than that of Appendix S8 is required.

In addition, Motorola provides plots of typical earth station ("CPE" or "customer premises equipment") antenna patterns.[20] Although these *typical* plots show first sidelobes at a level approximately 27 dB below peak gain, Lockheed Martin is particularly concerned about the width of the main lobe of the antenna pattern. At an off-axis angle of 4°, the gain value is on the steep slope of the main lobe of the antenna. Even small antenna pointing errors would

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[17] *Compare Celestri LEO Application* at App. B, Fig. 2-4, *with* Fig. 2-10 (Motorola states that the uplink Io/No is -2.5 dB without mitigation and -30 dB with mitigation).

[18] *See Celestri LEO Application* at App. B, Table 2-1.

[19] *See id.*

[20] *See Errata and Clarifications to Application of Motorola Global Communications, Inc. For Authority to Construct, Launch and Operate the Celestri Multimedia LEO System, a Global Non-Geostationary Orbit Satellite system in the Fixed-Satellite Service*, File No. 79-SAT-P/LA-97 (filed July 29, 1997)

significantly increase the gain towards a GSO satellite if an arc avoidance value of only 4° were used.

Finally, Motorola has not addressed the fact that there could be multiple co-frequency Celestri LEO earth stations causing interference into a single GSO satellite receive beam, particularly since the Celestri LEO satellite receive beams tend to be significantly smaller than their GSO counterparts. The Celestri LEO frequency reuse scheme involves the use of a seven-cell cluster within 432 receive beams per satellite, creating the potential for up to 60 or more earth stations transmitting co-frequency within the footprint of a single Celestri LEO satellite.[21] A 60-fold reuse factor is equivalent to approximately 18 dB of additional uplink interference when the aggregate effect of the Celestri LEO earth stations is taken into account. Additional uplink interference may also be caused by co-frequency transmissions from earth stations directed towards different Celestri LEO satellites (up to four Celestri LEO satellites may be visible at given times).

In light of these concerns about uplink interference from Celestri LEO earth stations into GSO FSS satellites, the Commission must ascertain from Motorola the off-axis gain characteristics of the Celestri LEO transmitting earth station antennas. The Commission should also require Motorola to demonstrate that an orbit avoidance angle of 4°, including realistic earth station pointing errors and main-lobe effects, would maintain the required off-axis gain towards the GSO arc.[22] Lockheed Martin supports the view that Motorola must also address the effect of

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[21] *See Celestri LEO Application* at 41-42.

[22] *See, e.g., Loral Comments, Appendix B.*

aggregate uplink interference, and not just *single-entry* uplink interference, in any further technical submission on how GSO FSS systems will be protected from interference.[23]

B. The Celestri LEO System Will Cause Unacceptable Downlink Interference Into Primary GSO FSS Systems

The interference scenario in the downlink direction is somewhat different from that on the uplink. Motorola has not taken this distinction into account and mistakenly assumes that the same avoidance angle necessary to mitigate uplink interference is sufficient to control interference from the Celestri LEO System into GSO FSS earth stations. As the downlink interference into GSO FSS systems from the Celestri LEO System would tend to be much worse than uplink interference, it is crucially important that this issue be addressed correctly.[24]

For the downlink interference analysis, as GE Americom pointed out,[25] it is necessary to consider co-frequency emissions from *other* Celestri LEO satellites which may be visible to the GSO earth station, not just the single Celestri LEO satellite close to the GSO arc. In particular, co-frequency emissions from in-line Celestri LEO satellites which may be transmitting in downlink beams other than that in which the GSO FSS earth station is located may cause

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[23] *See, e.g., GE Americom Petition, "Technical Issues Raised By Celestri NGSO Application* at 2; *Loral Comments* at 8

[24] Downlink interference from Celestri LEO satellites into GSO FSS earth stations tends to be much worse than uplink interference from Celestri LEO earth stations into GSO FSS satellites because of the distance differential between the interfering and victim stations.

[25] *See GE Americom Petition, Technical Issues Raised by Celestri NGSO Application* at 1.

interference. In these cases, the side lobe gain of the Celestri LEO satellite transmit antenna determines the level of interference into the GSO earth station.

The sharing scenario provided by Motorola would be significantly different if the correct factors are taken into account. The Celestri LEO application suggests that the residual Io/No during alignment situations remains constant at -17 dB when mitigation is applied.[26] This amounts to a reduction in interference of 42 dB compared to the situation where no mitigation is applied.[27] In order to achieve this level of interference reduction, the aggregate effect of all sidelobes from other co-frequency downlink beams (perhaps 60 or more on a single Celestri LEO satellite) must achieve 42 dB isolation. It is very unlikely that even one such beam could achieve this level of isolation, let alone 60.

In fact, the relative gain contours of the Celestri LEO downlink beams, which are provided in Figure IV-10 to IV-12 of the Celestri LEO application, only show that the gain rolls off to the -20 dB level for a single beam. With only 20 dB isolation, an additional 22 dB of interference must be included in the interference analysis to take account of the sidelobes from a single Celestri downlink beam (which would increase the Io/No figure from -17 dB to +5 dB). If the effects of multiple co-frequency Celestri LEO downlink beams are taken into account, the resulting worse case Io/No levels would be significantly greater than +5 dB.

Motorola also mistakenly assumes that the GSO FSS receive earth station characteristics meet the off-axis gain envelope contained in ITU-R S.672-3.[28] This ITU Recommendation is

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[26] *See Celestri LEO Application* at App. B, Fig. 2-10.

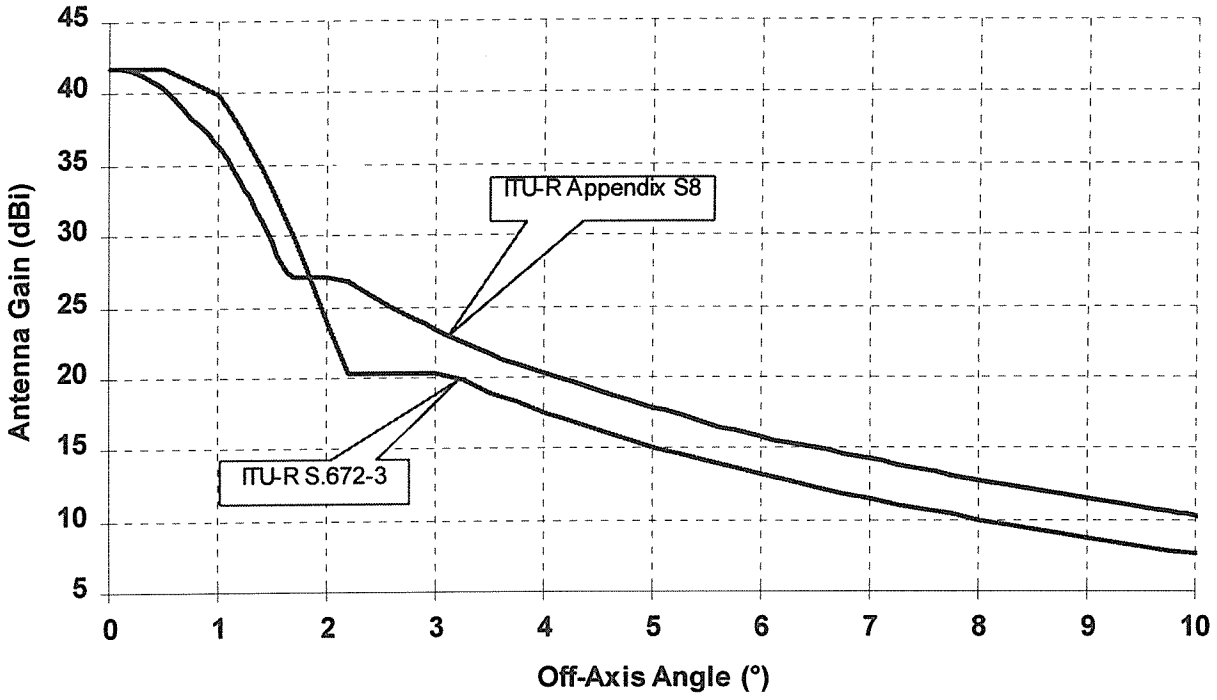
[27] *See id.* at App. B, Fig. 2-4.

[28] *See id.* at App. B, Table 2-1.

entitled "Satellite Antenna Radiation Pattern for Use as A Design Objective in the Fixed-Satellite Service Employing Geostationary Satellites," and clearly relates to *satellite* antennas, not *earth station* antennas.[29] A more appropriate off-axis gain envelope for this interference analysis would be the one that Motorola assumes for its own earth stations, which is given in Annex III of ITU Appendix S8 (entitled "Radiation Patterns For Earth Station Antennae To Be Used When They Are Not Published").

Figure 1, below, plots both of these off-axis gain envelopes for a 70 cm receive earth station antenna and shows that there is a considerable variation between them.

Figure 1 - Comparison of Antenna Off-Axis Gain Patterns (ITU-R S.672-3 vs ITU-R Appendix S8)



[29] *See KaStar Comments* at 3.

In the important off-axis angle range of 2° to 10°, the mask used in the Motorola analysis is between 3 and 6 dB more stringent than that given in Appendix S8. This results in a correspondingly more optimistic assessment of interference by Motorola's Celestri LEO System.

Motorola's proposed interference criteria for Celestri LEO interference into GSO FSS systems also contain significant technical inconsistencies or omissions.[30] In the Celestri LEO application, for example, Motorola proposes to use the interference criteria developed at CPM-95.[31] Although the CPM-95 interference criteria contain four data points, Motorola does not include one of these critical data points (Io/No = -12.2 dB for not greater than 0.87% of the time) because, even under its optimistic analysis, the Celestri LEO System cannot meet this criterion.[32]

Rather, in the *Celestri Sharing Study*, Motorola proposes to alter significantly the accepted CPM-95 interference criteria in a manner which is highly prejudicial to GSO FSS systems. Figure 2, below, demonstrates the substantial differences between the interference criteria.

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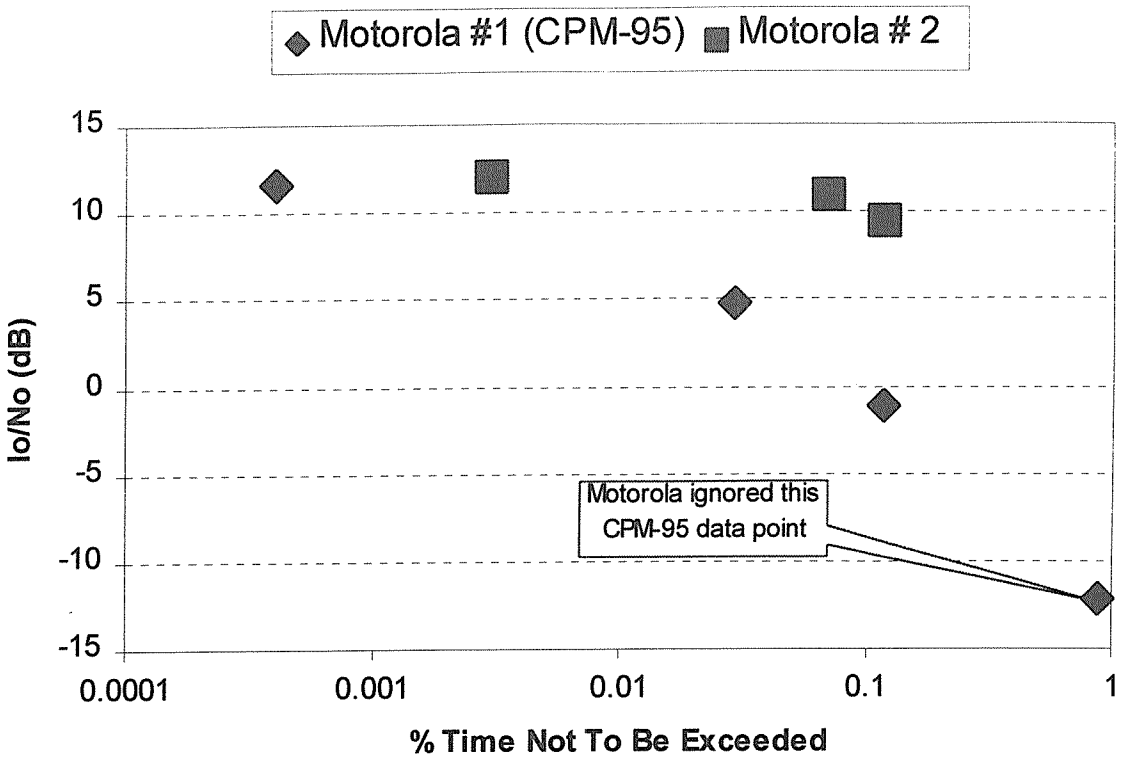
[30] *See generally GE Americom Petition; Loral Comments; KaStar Comments.*

[31] *See id.* at App. B, Fig. 2.2.

[32] *See id.*

Figure 2 - Comparison of CPM-95 Interference Criteria and New Proposal by Motorola (Celestri into GSO)



At the 0.1% level, for example, Motorola has proposed an interference criterion more than 10 dB worse than the CPM-95 criteria. It is procedurally inappropriate, and Motorola should not be permitted, to redefine established interference criteria through an ad hoc approach to match the characteristics of its system. Instead, in view of the secondary status of NGSO FSS operations in the primary GSO FSS bands, the Celestri LEO System must be redefined, at a minimum, to satisfy interference criteria that will ensure that no interference will be caused to GSO FSS systems.

Lockheed Martin takes this opportunity to elaborate on other technical issues that raise concerns about downlink interference from the Celestri LEO System. For example, Motorola proposes to operate TT&C links within its service bands. Although only a narrowband signal,

such emissions could still cause harmful interference to primary GSO FSS systems. Thus, the Celestri LEO System should avoid making TT&C transmissions in either the uplink or downlink direction at or near interference alignment situations with GSO FSS satellites. Such constraints should be factored into the Celestri LEO System design.

In addition, Motorola assumes that the GSO FSS receive earth station system noise temperature is 250°K. This may be an overly pessimistic assessment in view of current and expected advances in low noise amplifier technology for Ka-band systems. A more reasonable noise temperature of 125°K would result in a 3 dB difference in Io/No, which should be considered in the interference analysis.

In sum, Lockheed Martin submits that Motorola's analysis of downlink interference from the Celestri LEO System into GSO FSS systems is flawed in a number of significant respects. Correcting these discrepancies would result in an increased level of downlink interference. To address outstanding technical concerns, Lockheed Martin agrees generally with the majority of the commenters and petitioners that the Commission should require Motorola further technical analysis. Specifically, Motorola should provide a corrected downlink interference analysis that takes into account: (i) the cumulative effect of the sidelobes of all relevant Celestri LEO satellite transmit beams; (ii) GSO FSS receive earth station off-axis antenna gain in accordance with ITU-R Appendix S8; (iii) realistic, lower GSO FSS receive earth station noise temperatures; (iv) interference criteria which are in line with the CPM-95 criteria; and (v) Celestri LEO TT&C in-band operations. Lockheed Martin supports the view that the Commission, existing GSO FSS licensees and 2nd-round GSO FSS applicants may only evaluate accurately the potential

interference into GSO FSS systems from the proposed Celestri LEO System upon the performance and submission of a proper interference analysis.[33]

C. The Celestri LEO System Does Not Demonstrate the Technical Capability To Use Effectively Satellite Diversity

The discussion in Sections II.A and II.B, above, assumes that the Celestri LEO System will be able to utilize effectively satellite diversity as an interference mitigation technique. However, it is not clear that the Celestri LEO System design will permit the use of satellite diversity for earth stations in all geographic regions that Motorola intends to serve.[34]

Figure 3, a reproduction of Figure IV-5 of the Celestri LEO application (with shading added), shows the number of satellites in view from various latitudes on the Earth's surface. The hatched area indicates situations in which it is not possible to implement satellite diversity because only one satellite will be visible.

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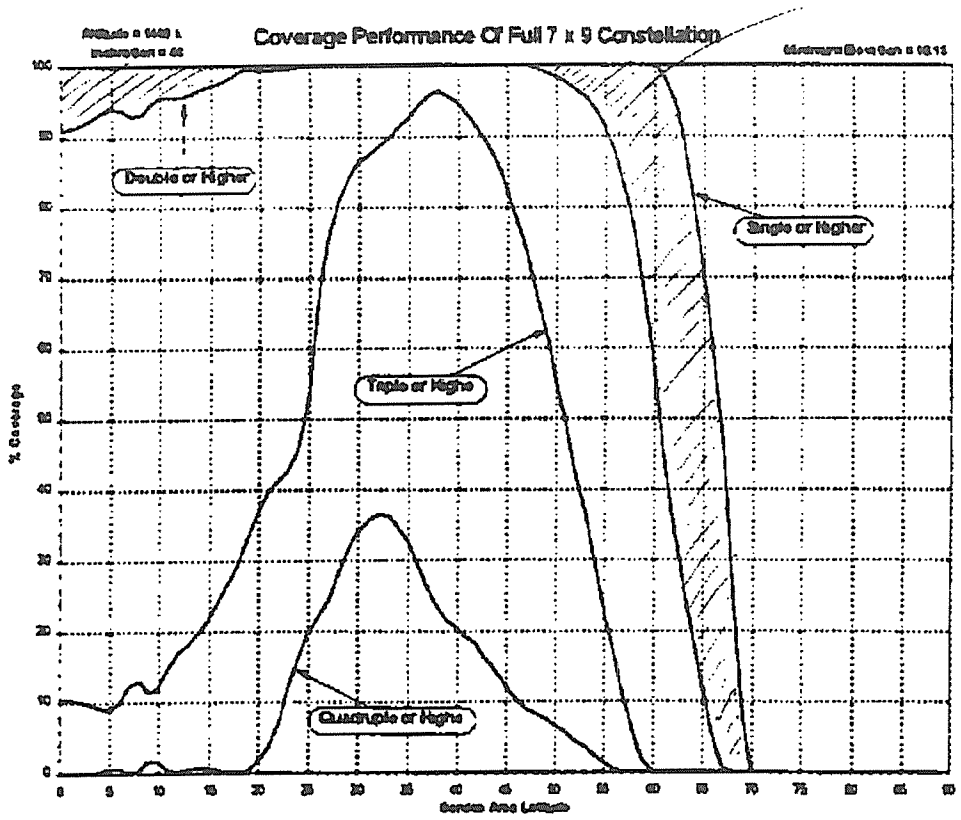
[33] *See generally GE Americom Petition; Loral Comments.*

[34] *See Loral Comments, Appendix A* at A-6.

Figure 3 - Celestri Constellation Performance



Motorola proposes to offer Celestri LEO services at latitudes of ± 60° (with a 16° minimum elevation angle), and up to ± 70° if lower elevation angles are used. At latitudes above ± 67°, satellite diversity cannot be utilized because there is never more than one satellite visible. At latitudes of ± 60°, there is only a 55 percent chance that more than one Celestri LEO satellite will be visible. Even at latitudes of ± 50°, which include high-population areas of Europe such as London, Frankfurt, Brussels, etc., the Celestri LEO System is unable to provide dual-satellite coverage at all times. A similar problem exists for latitudes below ± 20°.

During periods of single-satellite coverage, it is simply not possible to implement the satellite diversity technique for the purpose of preventing interference to GSO FSS systems. In the event of an interference alignment situation, the Celestri LEO System would either cause

unacceptable interference into GSO FSS systems or would have to cease transmissions. Given this situation, the Commission should require Motorola to demonstrate that the Celestri LEO System can and will implement an effective satellite diversity scheme in all situations where such interference might be caused to primary GSO FSS systems.

III. THE COMMISSION SHOULD AUTHORIZE CELESTRI LEO OPERATIONS IN PRIMARY GSO FSS SPECTRUM ONLY ON AN UNPROTECTED, NON-INTERFERENCE BASIS

In response to an FCC inquiry concerning its use of primary GSO FSS frequency bands, Motorola stated:

> in the 19.7-20.2 GHz and 29.5-30.0 GHz bands, Motorola is not requesting protection from interference caused by and will not cause unacceptable interference to any existing or future licensed GSO system operating in accordance with generally accepted industry standards and Commission rules.[35]

The Commission must hold Motorola strictly accountable on its commitment not to request protection from interference caused by, or to cause unacceptable interference to, GSO FSS systems operating in primary GSO FSS bands.

The Ka-band service rules are clear concerning provision of services in bands where a system does not have licensing priority:

> [We] will require any service provider proposing to operate in a band segment in which it does not have licensing priority, to operate on an unprotected basis to the priority service. To ensure non-interfering operations, we will require all secondary operators to submit to the Commission a technical demonstration that it can operate on a non-harmful interference basis to the type of satellite system with licensing priority.[36]

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[35] Letter from Philip L. Malet and James M. Talens to William F. Caton, File No. 79-SAT-P/LA-97 (Aug. 28, 1997) at 1.

[36] *See Ka-Band Service Rules* at ¶ 39.

As discussed in Section II, *supra*, and detailed by the commenters and petitioners, Motorola has not made the requisite technical showing that the Celestri LEO system can operate on a non-interference basis *vis-à*-vis GSO FSS systems in these bands.

Even if Motorola submits a satisfactory technical demonstration, it must nevertheless operate the Celestri LEO System on an unprotected, non-interference basis in the primary GSO FSS frequencies at 19.7-20.2 GHz and 29.5-30.0 GHz.[37] As noted in the Ka-band service rules:

> [the Commission] will require secondary users to immediately cease operations upon notification of harmful interference into any service or system that has superior status or licensing priority in a particular band segment.[38]

Thus, if the Commission is ultimately satisfied by a revised technical submission on the Celestri LEO System, and decides to authorize its secondary operations in the 19.7-20.2 GHz and 29.5-30.0 GHz bands, such an authorization must incorporate, and such operations must abide by, the limitations inherent in secondary licensing status.[39]

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[37] *Id.*

[38] *Id.*

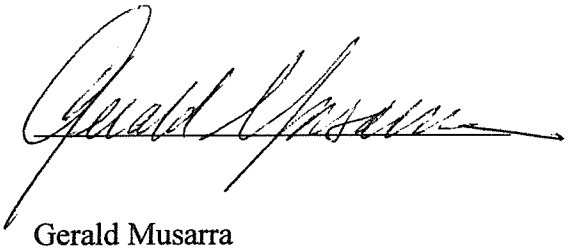
[39] It may be appropriate for the Commission to initiate a rulemaking proceeding to address collectively the issues raised generally regarding NGSO FSS use, on a secondary basis, of spectrum designated for GSO FSS use on a primary basis. As GE Americom noted in its Petition at 2, the Commission does not have a framework in place for assessing co-frequency operations by NGSO and GSO FSS systems.

II. CONCLUSION

For all of these reasons, Lockheed Martin agrees with those commenters and petitioners that urge the Commission to find that Motorola has not made the requisite technical demonstration concerning the ability of the Celestri LEO System to operate in primary GSO FSS spectrum on an unprotected, non-interference basis, and to require Motorola to submit further interference analyses to demonstrate that the Celestri LEO System will not interfere with GSO FSS systems operating in primary GSO FSS frequency bands.

Respectfully submitted,

LOCKHEED MARTIN CORPORATION

By: 

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TECHNICAL CERTIFICATE

The undersigned hereby certifies, under penalty of perjury, that I am the technically qualified person responsible for the preparation of the technical material in the foregoing Reply Comments of Lockheed Martin Corporation, and that such material is complete and accurate to the best of my knowledge and belief.

Richard Barnett

Richard J. Barnett
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Dated: January 22, 1998

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I, Jennifer A. Warren, hereby certify that true copies of the foregoing "Reply Comments of Lockheed Martin Corporation" were mailed, United States first-class postage prepaid, this twenty-second day of January, 1998, to the following:

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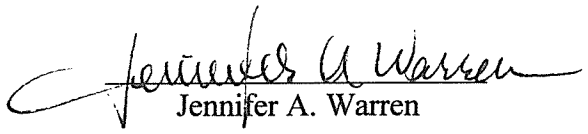

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