Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
FINAL ANALYSIS COMMUNICATION SERVICES, INC.	) File Nos.	7-SAT-AMEND-98;
	)	25-SAT-P/LA-95
Application for Authority to Construct	)	
Launch and Operate a Non-Voice	)	
Non-Geostationary Mobile Satellite System	)	

To: The Chief, International Bureau

OPPOSITION TO PETITION TO DENY

FINAL ANALYSIS COMMUNICATION SERVICES, INC.

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EXECUTIVE SUMMARY

Final Analysis Communication Services, Inc. ("Final Analysis"), by its attorneys, hereby submits its opposition to the Petition to Deny filed by Leo One USA Corporation ("Leo One") against Final Analysis's amended application for authority to construct, launch and operate a non-voice, non-geostationary mobile satellite service ("NVNG MSS" or "Little LEO") system. Leo One's Petition is unfounded and unsupported and should be dismissed.

The Commission has said that it will unconditionally accept amendments necessary to conform to the Commissions' policies and rules established in the *Report and Order* in IB Docket No. 96-220 released on October 15, 1997. Final Analysis's amendment fully conforms to the System 2 requirements. Among Little LEO systems, System 2's operating parameters are unique in that they require System 2 to share with numerous government and commercial satellite operations and full deployment of commercial Little LEO operations in the System 2 bands is dependent on the first-priority on allocation of future spectrum. The constellation parameters in Final Analysis's amended proposal balance the need to share on a non-interference basis with co-channel and adjacent operations in the System 2 bands while maintaining system availability adequate to commercial operations.

Final Analysis's probability studies discussed herein confirm that the request to increase the number of satellites and orbital planes in the FAISAT constellation while reducing the orbital inclination will preserve essentially the proposed level of availability for the constellation while not increasing overlap between Final Analysis's satellites and NOAA's satellites.

Final Analysis's amendment also identifies other operational characteristics that will allow its system to be deployed on a global basis under the unique operating characteristics

imposed on System 2. These characteristics include specifies channelization and data throughput capabilities, increased uplink transmitter power and increased downlink EIRP. Leo One does not demonstrate that these capabilities do not conform to System 2. Leo One also has not submitted any evidence or stated any claim that interference is created by these changes, and in fact admits that operation of Final Analysis's proposed system in compliance with System 2 parameters precludes creation of additional interference.

Thus, Final Analysis's changes cannot be deemed major amendments and should be accepted. Even if Final Analysis's proposed modifications might otherwise be considered major, they fit within the standard exemption under the Commission's rules that changes required by the Commission due to unforeseen circumstances are not treated as major amendments.

The expeditious grant of Final Analysis's amended system proposal will promote the Commission's goals of encouraging new competitive entry into global satellite markets by allowing Final Analysis to begin deploying its global, near-real time Little LEO system as quickly as possible.

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unfounded and unsupported. For the reasons detailed below, Final Analysis urges the Commission to dismiss Leo One's Petition and grant Final Analysis's amended application.

INTRODUCTION

Final Analysis's proposed changes are designed to comply with the *Report and Order*, including operating within the constraints of System 2 and allowing the system to use future additional spectrum. The specific changes include a modest increase in satellites, the addition of two orbital planes and a reduction in orbital inclination, increased downlink EIRP and increased uplink transmit power. Leo One argues that these changes must be deemed to constitute a "major amendment" and deferred to a future processing round. As detailed below, Leo One has not effectively disputed that Final Analysis's proposed system changes should be accepted unconditionally as required and appropriate to conform to the requirements of System 2. Further, it has not provided any evidence whatsoever that any of the changes will actually increase interference to any other applicant or operator.

Additionally, grant of Leo One's Petition would frustrate the purpose of this long and painstaking proceeding. The band plan prescribed in the *Report and Order* not only avoids mutual exclusivity and the necessity for resort to auctions, but also achieves the Commission's "Open Skies" objectives of (1) encouraging entry by qualified applicants, (2) discouraging "warehousing" of orbit-spectrum resources by those who will not use it or who are under-financed, and (3) providing operators with maximum flexibility to tailor their offerings to meet their customers' requirements.[2] In particular, the band plan is aimed at fostering for Little LEOs "an environment that promotes competition through new entry and

[2] *Report and Order* at ¶ 11.

produces new and innovative service offerings in the Little LEO service markets for the benefit of the United States public."[3] Leo One would have the Commission deprive the public of service from an innovative competitor, poised to enter the market immediately upon licensing. As there is no spectrum available for a third round, if not licensed here, Final Analysis's System 2 will not be licensed at all.

This is clearly not in the public interest. Final Analysis has invested over thirty million dollars in the development of its Little Leo system. It has built and launched two satellites; has built three commercial-quality ground stations; has developed its prototype user terminals; has implemented an International Awareness Program that will benefit the entire U.S. industry; has signed agreements with several of its National Service Providers and Value Added Resellers; and, has a contract for demonstration of utility applications. Final Analysis is by far the closest to market of any of the unlicensed applicants. Licensing Final Analysis as soon as possible in accordance with its proposed implementation of System 2 will best enable the Commission to achieve near real-time system competition quickly in the Little LEO marketplace.

In its Petition, Leo One itself recalls that the industry agreement underlying the second round applicants' Joint Proposal and the band plan set forth in the *Report and Order* was achieved only after long and difficult Commission proceedings and inter-company negotiations. Final Analysis agrees with Leo One that the amendments filed to implement the band plan should not upset the "delicate balancing of interests" that have been achieved. However, Final Analysis submits that it is Leo One that seeks to undo this important

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[3] *Id.*

achievement for its own competitive advantage.[4] The unreasonableness of this is underscored by the fact that no other party, including the experienced first round licensee ORBCOMM, raised similar concerns. In this context, Leo One's arguments completely lack credibility.

DISCUSSION

I. Final Analysis's Amendment Should be Unconditionally Accepted.

A. The Proposed Modifications Are Necessary to Bring the Final Analysis Application Into Conformance with System 2 under the *Report and Order.*

The Commission has made clear that it will unconditionally accept any "amendment that is necessary to bring an application into conformance with any rules and policies adopted in this *Report and Order*. All other amendments will be treated under our existing Rules."[5] Because each of the modifications Final Analysis proposed in its amendment are demonstrably necessary to bring its planned Little Leo system into compliance with the standards for System 2 set forth in the *Report and Order*, the Commission should accept the amendment under this standard.

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[4] Leo One, along with the other second round applicants, signed an agreement as part of the Joint Proposal to refrain from attacking other applicant's amendments except to the extent that the amendments had a direct impact on them. Leo One's Petition to Deny, which raises many issues totally extraneous to Leo One's own pending application, certainly violates the spirit of this agreement. Indeed, as it has throughout this proceeding, Leo One appears to oppose Final Analysis just for the sake of doing so and raises objections that, on close scrutiny, have no sound technical basis.

[5] *See Id.* at ¶ 131; *accord Little LEO First Round Order* at ¶ 26; *Starsys Order* at ¶ 17 ("major amendments 'necessary' because of 'obligations that [the FCC] ha[s] imposed upon applicants after the cut off date' would be permitted without treating the application as newly filed, even if the amendment does not otherwise comply with Section 25.116(c) of the rules").

Leo One mischaracterizes Final Analysis's proposals as "expanded constellation demands" that do not conform to the *Report and Order*. *See, e.g.*, Leo One Petition at 4. In fact, the proposed changes by Final Analysis in the design of its constellation are made solely to address the unique constraints imposed by System 2 parameters on the original Final Analysis system design by the requirements for time-sharing with NOAA and other systems, and would not be necessary in the absence of those requirements. The *Report and Order* outlined for the first time the technical parameters of time-sharing and future spectrum allocation for System 2. Accordingly, it was only in response to the *Report and Order* that Final Analysis had the opportunity to put on the record how it would implement a time-shared system. Clearly, its original system required modifications to effectively compete in the short term within System 2 constraints. Further, Final Analysis's amendment is designed to promote coordination as well as reduce the potential for interference.

1. System 2 Has Unique and Uncertain Characteristics.

The licensing features of System 2 are *sui generis* as defined by the Commission's policies and goals in the *Report and Order* and set forth in the band-plan established in the Joint Proposal. The unique attributes of System 2 as defined by the Commission are key in considering what constitutes an amendment that "conforms" to System 2. The Commission has broadly defined the potential product and geographic markets for Little LEO services as encompassing a wide range of commercial radio location and two-way data messaging services that will be provided "anywhere in the world using small, inexpensive transceivers."[6] Moreover, the Commission determined in the *Report and Order* that

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[6] *See Amendment of Part 25 of the Commission's Rules to Establish Rules and Policies* (continued...)

licensing two large, near-real time systems in Systems 1 and System 2, and a store-and-forward-type spread spectrum system in System 3, will best promote its goal of competitive deployment of Little LEO services in global markets by facilitating the entry of two new competitors to ORBCOMM's incumbent near-real time Little LEO system. This market analysis was fundamental to the Commission's approach to licensing the NVNG MSS second round. Thus, the ability of the System 2 operator to meet the market objectives that underlie the Commission's adoption of the band plan is absolutely critical to a determination of whether Final Analysis's amendment conforms to System 2.

However, the Commission also recognized in the *Report and Order* that the band-sharing plan imposes unique challenges on the System 2 licensee in meeting these competitive goals:

> A significant portion of the spectrum assigned to System 2 in the 137-138 MHz band is allocated on a secondary basis to the Little LEO service and must be shared on a non-interference basis with the United States government and foreign satellite systems operating primary services in such spectrum. Thus, this spectrum may be unavailable or of limited use to System 2 for service downlinks thereby threatening System 2's commercial viability and competition among service providers in the Little LEO service markets.

See Report and Order at ¶ 35 (footnote omitted). To ensure the ability of System 2 to configure and deploy a globally competitive Little LEO system in light of the heavily encumbered spectrum assigned to it, the Commission assigned a first priority on future

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[6](...continued)
Pertaining to the Second Processing round of the Non-Voice, Non-Geostationary Mobile Satellite Service, Notice of Proposed Rulemaking, IB Docket No. 96-220, FCC 96-426 at ¶ 24 (released October 29, 1996) ("*Second Round Little LEO Notice*").

downlink spectrum to System 2 only.[7] Thus, in the Commission's view, giving System 2 alone the unique flexibility to apply for future downlink spectrum is the best way to promote competitive, near-real time, entry into the global Little LEO market.[8]

The second round applicants would not have agreed in the Joint Proposal, and the Commission would not have ordered, that System 2 have such an unusual claim on future allocated spectrum if it were not integrally important to the achievement of the Commission's objectives in this proceeding that System 2 ultimately be implemented as a robustly competitive large constellation able to offer near real-time service. Appropriate technical modifications to Final Analysis's system design to make System 2 as competitive as possible should therefore be given deference by the Commission to the extent that they do not create additional harmful interference.

2. Without Modification to Final Analysis's System, Outage Conditions Due to Time Sharing Would Preclude Implementation of System 2 As Fully Competitive System Offering Near Real-Time Services.

In its Petition, Leo One continues to confuse and confound the record in this proceeding with respect to a very straightforward issue: the compliance of Final Analysis with time sharing requirements imposes a 35% outage condition on the availability of its system. This outage condition, described in detail in the record and summarized again

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[7] Final Analysis has confirmed on the record that it cannot implement a fully competitive system with only the spectrum assigned to System 2, necessitating both first priority on future additional spectrum as well as appropriate flexibility to operate most efficiently within the constraints of System 2.

[8] The Commission states: "Making available a limited amount of future downlink spectrum allocated for Little LEO services *solely to System 2* for the purpose of completing the implementation of its second round system is likely to result in three large systems capable of providing a wide range of Little LEO services." *Report and Order* at ¶ 35 (emphasis added).

below, renders it impossible, without system modifications, for Final Analysis to provide near real-time services in accordance with the Commission's market objectives in this proceeding.[9] There is absolutely no dispute between Final Analysis and Leo One as to the fact that this 35% outage condition occurs as a result of time sharing requirements.[10]

The confusion that Leo One tries to perpetuate does not have to do with the 35% outage, but rather with the impact of the outage on availability. Clear understanding of this effect requires recognition that Leo One in its Petition misstates and obfuscates certain critical aspects of Final Analysis's system: (a) Final Analysis's originally proposed system was designed to achieve about 85% peak availability and coverage; and (b) under conditions of time-sharing "availability" means something quite different from "coverage."[11] These important factors are discussed in detail below.

First, as proposed in its original 1994 application prior to time-sharing, the Final Analysis system of 26 operational satellites in four orbital planes of 66 degrees plus two polar orbiting satellites provided maximum system availability/coverage of 85 percent over CONUS. In other words, in that context Final Analysis's coverage -- *i.e.*, the percentage of time a satellite is in view with a 26 satellite constellation -- peaked at 85% between latitudes 40-50 degrees. This figure also is not disputed by Leo One and in fact is confirmed in Leo

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[9] *See, e.g.*, Comments of Final Analysis filed in IB Docket No. 96-220 on December 20, 1996 at Exhibit 2 p. 3 "Systems Analysis"; Comments of Leo One filed in IB Docket No. 96-220 on December 20, 1996 at Appendix E pp.16, 20, Tables 1 & 2.

[10] *See id.*

[11] *See, e.g.*, Leo One Petition at 8, IIA.

One's own filings.[12] Because the original constellation did not contemplate time-sharing, the availability is the same as coverage, 85%, that is, if the satellite is in view, it is available for use. Thus, in the absence of time-sharing, "coverage" and "availability" mean the same thing since when a satellite is in view it is always available. In contrast to Leo One's claims, Final Analysis has never asserted that either the coverage or availability of its proposed system would be 100%.[13]

Under the time-sharing requirements on the frequency band assigned to System 2 Final Analysis must resolve potential frequency conflicts with multiple government and commercial satellite operators, including NOAA, Chinese Metsat, the Russian Meteor system, Eumetsat, S80, E-SAT/System 3 and ORBCOMM. *See Report and Order* at ¶¶ 31-37. It is the imposition of these time-sharing requirements that results in the 35% outage that is undisputed between Leo One and Final Analysis. With the requirement for time-sharing, the terms "availability" and "coverage" can no longer be used interchangeably. Although a satellite may be in view "covering" the ground below, it will not be available for use if its footprint is overlapping a NOAA satellite's footprint and its transmitter is turned off

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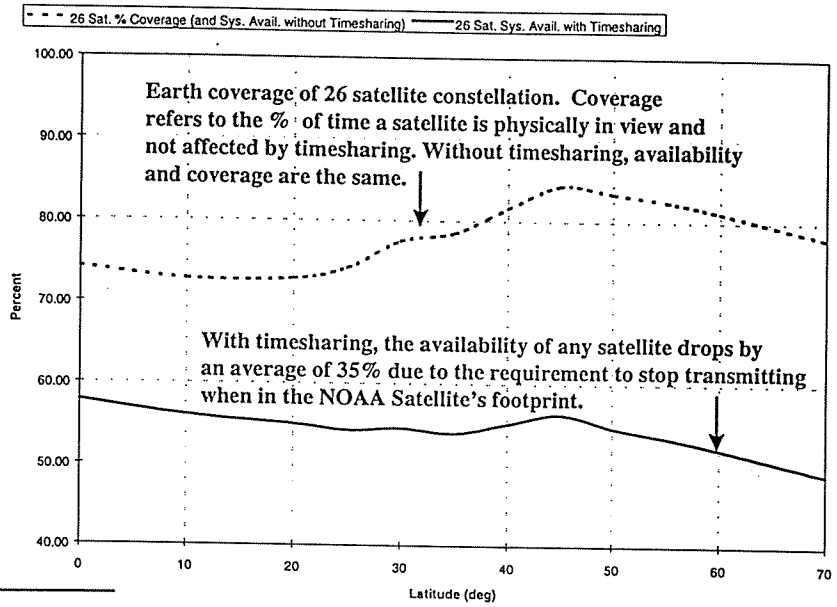
[12] Leo One's analysis, which is supplemented by an independent analysis by Autometrics commissioned by Leo One, confirms that the maximum availability of Final Analysis's originally proposed system is 85%. Indeed, Leo One states in its Petition that these analyses "all demonstrate that the original Final Analysis coverage was never 100% and in fact peaked at about 85%." Leo One Petition at 8. Leo One's Petition at p.4 of Appendix A states that these ". . . three separate analysis [*i.e.* Leo One's, Autometric's and Final Analysis's] all concur that the original Final Analysis design goals was for a peak availability of 85%."

[13] On p.4 of its Amendment, Final Analysis describes the original constellation design as providing coverage of CONUS of "approximately 100 percent." This statement describes the assumptions underlying the original constellation design described in Final Analysis's 1994 application and does not mean that Final Analysis would actually achieve 100% coverage. Final Analysis has always provided a more specific peak coverage definition of 85%. Consistently throughout its Amendment, Final Analysis refers to maximum coverage of 85%.

or switched to a different frequency. Thus, under time-sharing conditions that impose a 35% outage, coverage may remain the same, but *availability* will be dramatically reduced. This is a critical feature of the satellite constellation because, from a practical and consumer standpoint, the most important feature is the percentage of time the system can be used.

In particular, with time-sharing, coverage of a Final Analysis's 26 satellite constellation remains the same, but the availability of the system drops by 35% on average, peaking at an availability of approximately 55% at 40-50 degrees latitude.[14] The impact of time-sharing on a 26 satellite constellation is shown in Figure II-1a in the Final Analysis amendment and is restated in Figure IIA, below:



[14] This impact may be expressed mathematically as follows:

System Availability:	SA
System Coverage:	SC
Global Coverage (100%)	GC
If no time-sharing:	SA = SC

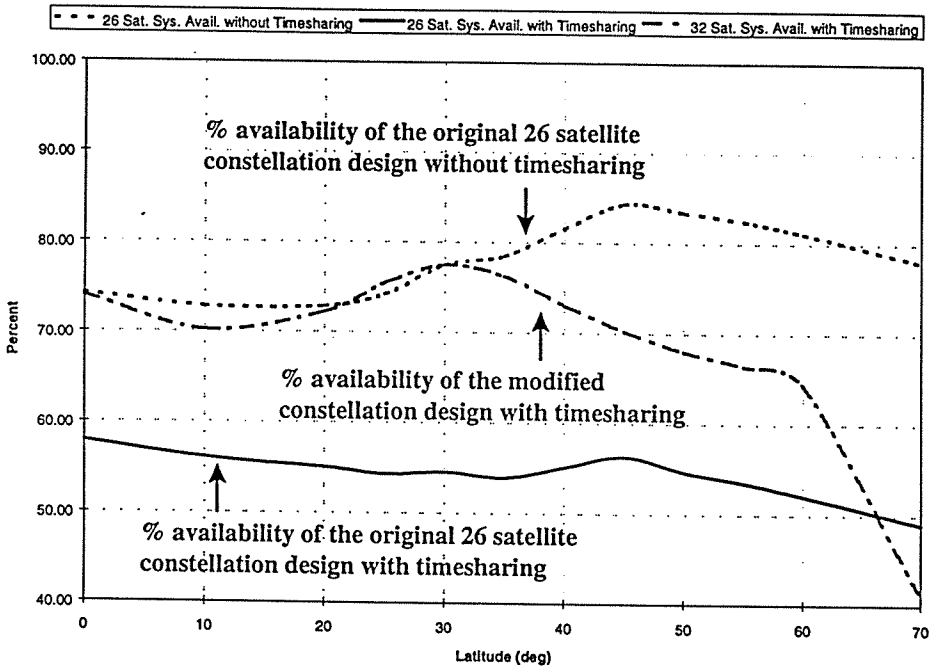
(1) FAISAT original coverage:	SC = .85 * GC
(2) Effect of time-sharing (35% outage):	SA = .65 * SC
(1)*(2) Timesharing effect on FAISAT:	SA = .65 * (.85 * GC)
	SA = .55 * GC

3. An increase in satellites and orbital planes to recover availability lost due to time-sharing is necessary and appropriate.

Final Analysis's proposal in the Amendment to increase the number of satellites and orbital planes must be viewed in the context described above, namely that the changes are required to achieve Commission objectives with respect to licensing a fully competitive System 2, without causing any increased harmful interference.

The constellation reconfiguration proposed in Final Analysis's Amendment balances the goals of avoiding harmful interference as required of System 2 while allowing sufficient flexibility to recover critical lost availability. While it is not possible to achieve the same availability as the original Final Analysis proposal which assumed no time-sharing, the proposed modifications substantially mitigate the 35% outage caused by time-sharing. Indeed, the modifications proposed to the original Final Analysis constellation design to comply with System 2 were done solely to try to come close to the original availability as possible, while recognizing that it would not be possible to recover all the availability lost due to timesharing.

As demonstrated in Figure IIB, below, the addition of 6 satellites to the FAISAT constellation provides an optimized response to offset the reduction in system availability below 85% due to time-sharing constraints imposed on System 2 by the *Report and Order*.



A comparison of the 32 satellite constellation's time-shared availability with the original design's availability without time-sharing demonstrates that the addition of the extra satellites allows the time-shared system to recapture almost all of the availability achievable under the original non-time-shared design up to slightly above 30 degrees latitude. While the modified design then provides less availability than the original plan for higher latitudes, a comparison with the original constellation still results in a significant increase in availability over the original 26 satellite design operating under time-sharing requirements until nearly latitude 70 degrees.

4. **The reduction in the inclination of the orbital planes will maintain the same footprint overlap rate with NOAA as the original constellation design.**

Leo One disputes Final Analysis's assertion that the modification in the inclination of the FAISAT satellites will reduce the potential for harmful interference to NOAA satellites.[15] However, based on an elementary mathematical calculation, it is demonstrable that Final Analysis's proposed reduction in orbital inclination will in fact cause the same probability of footprint overlap as the original constellation. Leo One's contrary conclusion is mystifying.

The individual elements of Final Analysis's modified system design were combined in such a way as to avoid causing any increase in the possibility of harmful interference. Specifically, the increase in the number of operational satellites to 32, and the number of orbital planes by two, substantially reduces the negative impact on availability due to timesharing, but increases the number of FAISAT-NOAA satellite footprint overlaps. To solve this problem and return the number of footprint overlaps to the same as that of the original constellation, the inclination of the primary orbital planes was reduced from 66 to 51 degrees. *In combination*, these changes will restore system availability sufficiently to allow a competitive system capable of providing availability close to the levels originally proposed without increasing the potential for harmful interference caused by footprint overlaps.

If Final Analysis had focused solely on improving system availability, then increasing the number of satellites and the number of orbital planes would have sufficiently met this goal. However, since Final Analysis's other major concern was not to increase the probability of additional FAISAT-NOAA satellite footprint overlaps occurring, Final

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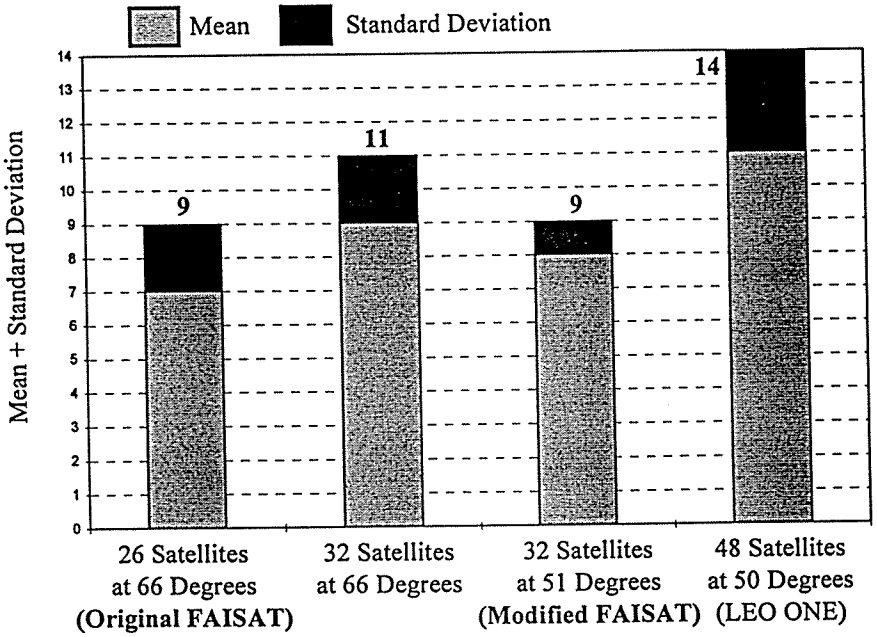
[15] Indeed, in Table 1 of Leo One's Petition to Deny, it states that Final Analysis's modified satellite configuration increases NOAA-FAISAT footprint overlap by 72%. This is incorrect. As shown in Figure 1, below, the number of footprint overlaps remains the same.

Analysis made other system changes, such as lowering the inclination of the orbital planes. These other system changes maintain the same maximum number of satellite footprint overlaps as the original system design. For harmful interference to occur two simultaneous events must take place: 1) the occurence of overlapping footprints between NOAA and FAISAT satellites; 2) the transmission by these satellites on the same frequency. The Final Analysis amended configuration does not increase the probability of maximum satellite footprint overlaps and therefore does not increase the possibility of harmful interference.

Specifically, as shown in Figure 1 below and in Appendix A attached hereto, the maximum number of NOAA satellite footprint overlaps produced by the 26 satellite FAISAT original system configuration is 9. The amended constellation design of 32 satellites with a primary orbital inclination of 51 degrees produces the same maximum number of footprint overlaps -- 9. On the other hand, adding satellites without reducing inclination would have increased the maximum number of overlaps to 11. Figure 1 also shows that a meteorological satellite system required to timeshare frequencies with FAISAT will always experience less potential interference than a system required to timeshare with Leo One.



This constellation design is the optimal choice balancing the goals of availability, cost-effectiveness, coverage, and minimization of interference to NOAA in order to use the spectrum available most efficiently to provide near-real time competition to Leo One and ORBCOMM.

During the negotiations between the FCC and NTIA which resulted in the two government users each agreeing to timeshare with a commercial system, there was no assumption made as to which applicant would be assigned which spectrum. The only assumptions that resulted were that the two government users -- NOAA and AF DMSP -- would each timeshare with only one commercial system. The possible commercial systems for sharing were limited by the current applicants in the second licensing round. Therefore, either government user -- NOAA or DOD -- could have ended up timesharing their system with as many as 48 satellites in orbital planes inclined 50 degrees, since this is the constellation size and inclination of the Leo One system. Nothing in the record indicates that either NOAA or DOD ever put any ceiling on the number of satellites it would share with --

only that they would share with just one commercial system. Given that Final Analysis proposes 32 satellites with orbital inclinations of 51 degrees, and considering that the "national security significant" DMSP presumably would be willing to share with a 48 satellite constellation, the impact on NOAA of timesharing with this number of satellites at a 51 degree inclination should be considered acceptable.

Leo One criticizes Final Analysis for not proposing to include frequency hopping capabilities in its user terminal design to ameliorate the availability problem described above. However, such modifications focuses on only one method of increasing availability -- namely, greatly increasing the cost of the customer terminal to enable frequency hopping. Final Analysis has stated repeatedly in this proceeding that it believes that employing frequency-hopping user terminals reduces the competitiveness of the service and is not cost-justifiable.[16] In contrast, Final Analysis will employ frequency agility in its satellites. Final Analysis's business strategy of building low-cost user terminals for only one receive frequency to maximize affordability and reliability of service, especially for price-sensitive market segments, is consistent with international goals for global Little LEO services.[17]

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[16] Leo One states that, since Final Analysis's terminals cannot change frequency, the fact that more satellites may be in the sky (because of the increase in the constellation size) does not increase the availability to that terminal as the satellites must all be turned off in the footprint of a NOAA satellite. As noted above, this comment incorrectly presumes that terminal frequency hopping is the only way to increase availability.

[17] For instance, the goal of encouraging global circulation of affordable MSS user terminals was established as a fundamental principle at the 1996 International Telecommunications Union World Telecommunications Policy Forum on Global Mobile Personal Communications by Satellite.

Presumably because the Commission recognizes that there is a difference of opinion between Leo One and Final Analysis on this point, it has expressly declined to mandate frequency hopping in terminals for Little LEO services.[18]

B. Other Design Changes To Increase Efficiency Without Interference Are Justified and Not Appropriate For Consideration As Major Modifications.

1. FCC satellite licensing policies permit significant flexibility in constellation design.

Leo One's complaints concerning uplink and downlink channelization configurations and data throughput capabilities specified in Final Analysis's amended application attack features that the Commission does not customarily consider in licensing satellite applicants. In fact, the Commission's satellite licensing procedures afford satellite applicants significant flexibility in optimizing the technical capabilities of their system designs.

For instance, in the 1996 *Part 25 Streamlining Order*, the Commission eliminated requirements that satellite applicants submit market-oriented data in their applications regarding demand for services, entities to be served and estimated transponder capacity.[19] The Commission found that it was not necessary to review this type of market-oriented information in the application process to reach a public interest determination as to whether licensing a particular satellite applicant would "help the U.S. satellite industry to continue to expand and compete in world-wide telecommunications market." *Id.* at ¶¶ 2, 11.

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[18] *See Report & Order* at ¶ 84 ("we will not mandate the use of frequency hopping").

[19] *See, e.g., Streamlining the Commission's Rules and Regulations for Satellite Application and Licensing Procedures*, 11 FCC Rcd 21581 at ¶ 11 (1996) ("*Part 25 Streamlining Order*").

In the Big LEO licensing context, the Commission also has afforded satellite applicants that conform with the band plan the flexibility to build additional capacity into their system designs. The Commission has allowed Big LEO applicants to specify a number of technically identical in-orbit spare satellites that would remain inactive until needed to meet future capacity requirements.[20] The Commission also has permitted Motorola the flexibility to build portable receive terminals as part of the Iridium system with additional capability to operate across an entire band allocated for pertinent system architecture.[21] Thus, within the parameters set forth in the band-sharing plan in the *Report and Order*, the Commission's satellite licensing policies and rules do not restrict a Little LEO applicant's flexibility to configure the market-oriented technical parameters of their systems such as service channelization and data throughput parameters, and to build additional capacity into their systems to meet future market demand. This kind of flexibility is very important for Final Analysis as it must be prepared to operate in the uncertainties of a global market which includes the need to coordinate with foreign systems as well as the possibility that future spectrum may not materialize.

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[20] *See Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands,* Notice of Proposed Rulemaking, 9 FCC Rcd 1094 at ¶ 82 (1994) ("*Big LEO Notice*"); *Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands*, Report and Order, 9 FCC Rcd 5936 at ¶ 182 (1994) ("*Big LEO Report and Order*").

[21] *See Application of U.S. Leo Services, Inc., for Blanket Authority to Construct and Operate Up to 200,000 Portable Handheld Earth Stations for Use with the Iridium System in the 1616-1626.5 MHz Band*, Order and Authorization, 11 FCC Rcd 20474 at ¶ 15 (1996) ("*U.S. Leo Services*").

Final Analysis is planning to build a global system, and certain design characteristics described in the Amendment are designed to meet that global demand. The wisdom of building flexibility and optimizing capability in the Final Analysis system design and business strategy is underscored by the licensing constraints imposed on System 2, particularly the need to design for unknown future spectrum allocations. The unique spectrum limitations on existing bandwidth assigned to System 2 and its dependency on future spectrum allocations, requires Final Analysis to build additional capacity and flexibility into its system design to allow it to pursue a competitive global market strategy.

Provided that Final Analysis conforms with the band plan and operating requirements assigned to System 2 in the *Report and Order* and does not increase the potential for harmful intersystem interference, nothing in the Commission's satellite licensing rules or policies precludes Final Analysis's from including design changes in its Amendment that maximize the efficiency and utility of its proposed constellation.[22]

2. Final Analysis's proposed uplink and downlink configurations do not constitute a request for more spectrum.

Leo One complains that Final Analysis has proposed to increase feeder downlinks, service downlinks and feeder uplinks. Petition at 5, 16. Final Analysis is not asking for additional authorization to utilize more links than the System 2 spectrum will support. However, Final Analysis anticipates gaining future spectrum and will need the ability to utilize this spectrum in the future. This spectrum may or may not include global allocations. In fact, experience at WRC-95 and WRC-97 indicate that future allocations for Little Leo

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[22] *See, e.g.,* 47 C.F.R.§ 25.142, reflecting primary focus in licensing NVNG MSS systems on preventing harmful interference and ensuring that the proposed system is financially viable.

systems may be on a country-by-country basis. Therefore, it is important for Final Analysis to have the capability of using a wide range of possible future frequency allocations, and must add this capability to its satellites now. In its amendment, Final Analysis has proposed changes in the number of feeder and service links that would result in the most optimized and efficient use of the Final Analysis system, taking the uncertainties of future allocations into account.

Moreover, Leo One's assertion that Final Analysis proposes to increase its use of limited shared uplink channels by increasing the number of satellites and by increasing the number of receivers from 12 per satellite to 40 is incorrect. Leo One Petition at 11. In fact, Final Analysis's amendment does not propose to increase its *use* of uplink channels; rather, it proposes merely to increase the number of radio receivers on each satellite from 12 to 40. This is a design feature of the satellites consistent with the Commission's goal of promoting efficiency and flexibility in satellite designs to be capable of global market operation.[23] Leo One confuses technical design with proposed operations according to licensed parameters.[24] Finally, Final Analysis's service uplink configuration is designed to

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[23] *See Report and Order* at ¶ 11; *see also U.S. Leo Services*, 11 FCC Rcd 20474 at ¶ 15.

[24] For instance, Final Analysis is proposing to install UHF, VHF and L-Band receivers on each satellite, despite the fact that currently there is no L-Band frequency authorized to Little LEO use. In case such future L-band use is authorized for Little LEOs, however, Final Analysis will be able to use that frequency without having to build and launch replacement satellites. Such efficiencies can be passed on to consumers. Similarly, the Commission has allowed Big LEO applicants to specify capacity in the feeder link segment of their systems in anticipation of future allocation of Ka Band spectrum. *See Application of U.S. Leo Services, Inc. for a License to Construct and Operate Transmit-Receive Gateway Fixed Earth Station Facilities for Use with the Iridium System in the 19.4-19.6 GHz and 29.1-29.3 GHz bands*, Order and Authorization, 11 FCC 13962 at ¶¶ 13-15 (1996) (allowing (continued...)

accommodate increased capability for additional service uplink usage, in relation to fluctuating market demand. Final Analysis is merely adding the capability to use additional service uplinks, but actual usage will be dependent on marketplace success. Use of service uplinks is dependent on the number of ground transmitters actively using the spectrum to transmit earth-to-space messages. In the case of service uplinks, these transmitters are customer units. In other words, how heavily service uplink channels are used is dependent solely and completely on how many customers the system has. Thus, use of uplink channels is a measure of market success or failure. A system with one million customers will use more uplink channels than will a system with ten customers. Accordingly, Leo One's claim that Final Analysis's service uplink configuration "significantly increases interference into the Leo One system, virtually precluding operations, and should be deemed a major modification" reveals a total misunderstanding of the effect of market demand on actual service uplink usage.[25]

3. Final Analysis's proposed increase in data rates up to 307 kbps is a necessary design feature to compete in global markets.

Final Analysis expects to offer larger file transfer capability, if authorized to do so, in countries outside the U.S. This is consistent with the company's strategy of building a flexible system with global capabilities. Leo One acknowledges as much in its Petition, citing Final Analysis's international presentations on "the capability to service *international*

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[24](...continued)
Big LEO feeder link channels flexibility to be conformed to rules adopted in pending Ka Band allocation proceeding).

[25] Leo One Petition at 11. We note that ORBCOMM, an experienced service operator, does not mention this change as a concern in apparent concurrance that only the number of customers, not the number of satellite receivers, affects uplink use.

markets with high data rate file transfers." Leo One Petition at Appendix A, p.6 (emphasis added).

Again, Final Analysis is not seeking authorization for capacity beyond that of System 2. Moreover, within its use of System 2's authorized bands, Final Analysis should be permitted to transmit at whatever data rate the frequency can accommodate as long as these transmissions meet all coordination requirements and do not cause harmful interference to other users. The Commission's satellite licensing rules and policies afford Final Analysis the flexibility to maximize efficient use of its bands.[26] Under Leo One's overly strict reading of Commission licensing processes, all Little LEO technical operating characteristics would be micro-managed by the Commission's licensing processes. Not only is there no support in the Commission's rules or policies for this, but such an approach would be antithetical to the Commission's current efforts to streamline licensing while promoting efficiency and innovation.

4. The increase in uplink power from 10W to 20W is necessary to have an operational system.

Based on its satellite research and development program, Final Analysis has learned that in order to achieve reliable service link operations, its terminals should be able to transmit as high as 20W. Leo One mistakenly asserts that this increase in uplink power from 10W to 20W "[e]nsures Final Analysis will be able to overpower a Leo One transmission in the event of competing uplink transmissions". *See* Leo One Petition at Table 1 -- Issue 6. Leo One's comments on this point reflect an elementary error.

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[26] *See, Part 25 Streamlining Order*, 11 FCC Rcd 21581 at ¶ 11; *Report and Order* at ¶ 11; *see also U.S. Leo Services*, 11 FCC Rcd 20474 at ¶ 15.

As Final Analysis indicated in Figure II-10 of its Amendment (as modified by its November 4 Errata), the Final Analysis system requires a signal-over-noise ratio (Eb/N0) of 13.5dB. Overpowering Leo One's 7W uplink transmission would therefore require Final Analysis's user terminal to transmit in excess of 150W. Indeed, this 150W number includes no margin and the addition of a minimal operational margin of 3dB would result in a user terminal transmitting in excess of 300W. This is completely unrealistic and bears no relationship to Final Analysis's actual system design.

In the real world, if both the Leo One and FAISAT systems select the same channel and attempt to transmit on the same frequency, both systems will experience loss of signal. This will happen regardless of whether the FAISAT system transmits at 10W or 20W.

This potential loss of signal due to simultaneous transmission is precisely the reason why a reliable DCAAS-type operation is so crucial for uplink coordination. Both ORBCOMM and Final Analysis have invested significant resources in the development of their scanning software, and feel that coordination and interference avoidance is technically feasible and not difficult to achieve.[27] If Leo One is truly concerned about uplink transmissions in this band overpowering their system, their concern would be more appropriately focused on paging systems which operate in the same band and transmit in excess of 100W.

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[27] Contemporaneous with this filing, Final Analysis and ORBCOMM are separately filing a Joint Letter with the Commission reflecting their shared view that coordination of DCAAS-type operations can be achieved and recommending an approach to facilitate coordination without risk of compromise of proprietary software algorithm. Final Analysis and ORBCOMM are amenable to having Leo One participate in this process as well.

5. **The increase in downlink EIRP from 12.8dBW to 17.8dBW does not cause harmful interference and is necessary to have an operational system.**

Leo One states that for FDMA systems, the increased power poses an increased threat of out-of-band emission generated by Final Analysis operations in the 137.025-137.175 Mhz band. As explained in detail in Appendix B, Final Analysis downlink transmissions, using GMSK modulation, are such that adjacent channel operations without harmful interference are readily achievable and are acceptably even by the "voice-sensitive" operations of the U.S. Cellular Industry Standards.

Over the past several years Final Analysis has devoted significant time and resources in the development of its GMSK modulation practices. Its GMSK scheme was ultimately implemented and tested in the FAISAT-1 and FAISAT-2v experimental satellites. The result of its R & D program demonstrated that GMSK was by far the superior technology for minimization of out of band emissions, and as implemented by Final Analysis produces results well within industry standards. Specifically, the U.S. cellular industry finds acceptable out of band emissions which are less than 25.2 dB below carrier power in a 25 kHz channel. The Final Analysis system, in actual performance tests, produces out of band emissions in the 137 and 400 bands 35.2 dB and 36.2 dB (respectively) below carrier power, a value comfortably in the acceptable range and well within the coordination capabilities of the parties.

Final Analysis believes that in order to resolve the out of band emission concern, the characteristics of both adjacent users must be studied. As stated in its comments, Final Analysis has significant concern with respect to Leo One's out of band emission in both 137 Mhz and 400 Mhz bands. Further as described in the separately filed Reply Comments to

ORBCOMM'S comments, Final Analysis has begun a coordination effort with ORBCOMM and there seem to be no concern between the two companies that coordination of downlink operations can be successfully completed.[28]

C. Final Analysis's Proposed Use of the 137 MHz Band is Consistent With System 2 Parameters.

Leo One objects in its Petition at p.16 to Final Analysis's statement that it would like to retain the flexibility to use a portion of the 137 MHz spectrum for service links. Leo One contends that such use by Final Analysis is inconsistent with the band plan in the *Report and Order*, and specifically the priority given to System 2 for assignment of future allocated spectrum based upon the limited availability of service links in the 400 MHz band. Leo One again mischaracterizes Final Analysis's proposal.

First, it is important to note that in the *Report and Order*, the Commission was silent on whether Final Analysis should use the 137 MHz frequency for service or feeder links. In fact, as stated in its Amendment on p. 25, Final Analysis intends to use the 137 MHz band primarily for feeder links. Final Analysis also prefers and intends to operate its service links in the 400 MHz band. However, it is clear that there is insufficient spectrum now for 400 MHz service links for System 2 and that the prospects for additional spectrum are uncertain. Thus, unless and until additional spectrum becomes available, the service capacity of System 2 is significantly constrained. In such circumstances, it would not serve the public interest to constrain the ability of the System 2 operator to put service links in the 137 MHz

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[28] Leo One also claims that Final Analysis' proposed downlink operations in the 137 MHz would increase degradation to E-SAT and S80. However, we note that E-SAT has not submitted any comments on the Final Analysis amendment and has not raised any concerns regarding downlink coordination. Downlink coordination with S80 will be done in collaboration with the FCC after Final Analysis is licensed.

band on an interim basis in order to enable it to most efficiently use the System 2 spectrum. Rather, it is consistent with the Commission's goals for Little LEOs that Final Analysis have the ability in the interim to develop a competitive system. A competitive system is not possible using only the 400 Mhz band assigned to System 2 for service links, as Final Analysis has stated on the record.[29]

Moreover, there are many users of the 137 MHz band that Final Analysis must timeshare with, including but not limited to NOAA, Eumetsat, Chinese MetSats, and the Russian Meteor system. Given this expected level of sharing and coordination in the band, a Little LEO system operator must build in flexibility into the system design, and Final Analysis's subscriber link proposal is designed to accommodate this flexibility in accordance with the future spectrum rights granted it by the *Report and Order*. Given that additional future spectrum may not be agreed to, and given that the heavy use of the 137 MHz band may yet preclude its use for service links, it would be premature to conclude, as Leo One does, that additional service link capacity is unnecessary. Final Analysis's request for additional subscriber links in the 137 MHz band therefore is consistent with its first priority on future spectrum, rather than in contravention of it, as Leo One alleges.

III. The Modifications Proposed By Final Analysis Are Not "Major Amendments" Under Section 25.116 Of The Commission's Rules.

Even if it were the case -- and it is not -- that Final Analysis's proposed changes in its Amendment are not required to conform to the System 2 requirements in the *Report and Order*, Leo One has failed to show that the proposal in Final Analysis's amendment to

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[29] *See* Letter from Aileen A. Pisciotta and Peter A. Batacan, Counsel for Final Analysis Communication Services, Inc., to Mr. Peter Cowhey, Chief, International Bureau, filed in IB Docket No. 96-220 on August 28, 1997.

increase the number of satellites in its constellation, reduce the inclination of the orbital planes and increase the number of orbital planes is a "major amendment."[30] The FCC does not view changes in the number of satellites, orbital planes or orbital inclinations as *per se* "major" amendments under Section 25.116(b), and has, in fact, treated such modifications as minor under its processing rules.[31] Moreover, Leo One has failed to show that Final Analysis's amendment meets the definition of a "major amendment" as set forth in Section 25.116(b).

The FCC's rules require that an amendment be considered "major" if it: (1) changes orbital locations; (2) changes the proposed frequencies; or (3) increases the potential for interference. 47 C.F.R § 25.116(b)(1). Unless a proposed change falls within one of these three specific categories of changes, the Commission will not consider it to be a "major" amendment under Section 25.116. None of the changes for which Final Analysis requests Commission authorization in the instant amendment qualifies as a major amendment.

The first factor -- changes in orbital locations -- is inapplicable to the amendment proposed by Final Analysis. The FCC has recognized that "any discussion of orbit locations is inapposite [in an application for a Little LEO system], as LEO systems operate in orbital planes, and are not assigned to specific -- and scarce -- geostationary orbital slots." Consequently, Leo One's arguments concerning proposed changes in the satellite configuration of Final Analysis Little LEO system are misplaced.

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[30] *See* Leo One Petition at 8.

[31] *See Orbital Communications Corporation for Authority to Construct, Launch and Operate a Non-Voice, Non-Geostationary Mobile-Satellite System*, 9 FCC Rcd 6476 at ¶¶ 19, 26 (1994) ("*ORBCOMM Order*").

Similarly, the second factor -- changes the proposed frequencies -- does not apply to the amendment proposed by Final Analysis. Final Analysis has proposed to use only the frequency specified for System 2 in compliance with the rules and policies adopted in the *Report and Order*, and Leo One has not alleged otherwise.

Finally, Leo One has failed to show the third factor, namely that Final Analysis's proposed amendment would increase the potential for intersystem interference. Indeed, Leo One cannot make such a showing because, as discussed above, Final Analysis's amendment conforms with the *Report and Order*'s time-sharing requirements and will not increase potential interference conflicts. In fact, Leo One admits in its Petition that, as long as Final Analysis conforms with System 2 requirements, its technical design proposals to build future capability into the ". . . preclude[] additional interference." *Cf.* Leo One Petition at 5.

This analysis is consistent with past Commission's rulings. For instance, in the first round Little LEO licensing proceeding, ORBCOMM proposed to increase the size of its constellation from 20 to 36 satellites and to lower its satellite orbits. In rejecting Starsys's and dBx's claims that ORBCOMM's proposed amendments were "major" under Section 25.116(b), the Commission held that, even though ORBCOMM's increase in the number of satellites and lowered satellite orbit might increase the visibility of ORBCOMM satellites in the shared bands, the amendments were not major where ORBCOMM also made changes to its system proposal, such as coordination of downlinks with Starsys, that would actually reduce the potential for intersystem interference in the band. *ORBCOMM Order* at ¶¶ 18-19. Moreover, the Commission found that ORBCOMM's amendments were not "major" under Section 25.116(b) -- notwithstanding the increase in the number of satellites and reduction in satellite orbits -- because the amendment did not increase the potential for interference. *Id.*

at ¶ 26. Similarly, Final Analysis's proposal to increase the number of satellites and reduce the inclination of the FAISAT constellation will not increase potential interference and is therefore not a major amendment.

Moreover, the *ORBCOMM Order* rejected dbX's claim that ORBCOMM's amendment was "major" under Section 25.116(b) to the extent that it proposed a change in frequencies. The Commission stated that:

> . . . to the extent that the [ORBCOMM] amendment proposes minor frequency changes, these changes have been incorporated to resolve frequency conflicts with [Starsys], and are thereby acceptable under an exception to the dismissal rule found in Section 25.116(c)(1).

Id. at ¶ 26. Under Section 25.116(c)(1), an NVNG MSS application amended by a major amendment -- such as a change in frequency -- that is filed after the cut-off date is excepted from the rule that it be deemed "newly filed" as of the date of the major amendment and dismissed or deferred to a future processing round, if the proposed frequency change actually resolves frequency conflicts. Similarly, given that the band-sharing plan agreed to in the Joint Proposal and the rules and policies adopted in the *Report and Order* are designed to resolve frequency conflicts among the second round NVNG MSS applicants and other users in the shared bands, and that Final Analysis's amendment is designed to conform its system frequencies to the frequencies assigned to System 2 in the Joint Proposal and the rules and policies of the *Report and Order*, Final Analysis's amendment will resolve frequency conflicts and is excepted from the dismissal rule.

In contrast, the *Starsys* case on which Leo One relies for the proposition that Final Analysis's amendment is major under Section 25.116 is distinguishable. There, Starsys had proposed to amend its application to add frequencies that were *not* part of the first round

joint sharing arrangement and did not incorporate coordination with other users of the band and, therefore, would have increased frequency conflicts.[32] In view of Starsys's failure to request the frequencies that were assigned to it under the first round joint sharing agreement, the Commission found that the Starsys frequency amendment would increase frequency conflicts and therefore treated it as major and did not except Starsys's amendment from the dismissal rule contained in Section 25.116(c)(1). Unlike *Starsys,* the Final Analysis amendment is designed to conform the FAISAT constellation to the System 2 frequency assignment and operational parameters defined in the Joint Proposal and the *Report and Order*, and thus will resolve frequency conflicts.

Accordingly, Final Analysis's proposal to increase the number of satellites, reduce its orbital inclination and increase the number of orbital planes are not grounds for finding that Final Analysis's amended application should be dismissed as a major amendment under Section 25.116. These proposals will reduce intersystem frequency conflicts and conform to the Joint Proposal and the Commission's *Report and Order.*

IV. The Modifications Proposed By Final Analysis Were Necessitated By Events Not Reasonably Foreseeable At The Time of Filing And Would Not Increase Frequency Conflicts.

Notwithstanding the *Report and Order*, Section 25.116 of the Commission's Rules include an exemption for amendments that are demonstrably necessitated by events which the applicant could not have reasonably foreseen at the time of filing and that would not increase frequency conflicts. As demonstrated herein and by the long pendency of this proceeding,

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[32] *See* Leo One Petition at 14-15 (citing *Starsys Global Positioning, Inc.*, 11 FCC Rcd 1237 at ¶¶ 17-21).

the requirements of the *Report and Order* plainly were foreseeable at the time Final Analysis filed its initial application. Moreover, Leo One has admitted that the proposed modifications would not increase frequency conflicts under System 2 parameters. *See* Leo One Petition at 5, 16. Because Final Analysis intends to operate in full compliance with any System 2 license it receives, the proposed Amendment, by definition and by Leo One's own admission, would not cause additional interference.

V. If the Commission Adopted the Standard Proposed by Leo One, Other Applicants Should Be Disqualified As Well.

If the Commission accepts Leo One's analysis and finds that Final Analysis's technical system modifications to its original application are major modifications requiring dismissal of Final Analysis's application, by the same token, Leo One's modifications to its original application warrant dismissal of its application. Leo One's claim that the proposal in Final Analysis's amendment to increase the number of its orbital planes is a major amendment is undermined by Leo One's own proposed modification to its system. Namely, in its second amendment to its original system application filed on November 16, 1994, Leo One increased the number of orbital planes in its system from four in its original application to eight. *See id.* at 2. Yet Leo One claimed in that filing that its proposed doubling of the number of orbital planes was a minor amendment that was *necessitated to increase service availability*.[33] Leo One also deleted its inter-satellite link. *See id.* In its October, 29, 1997 Amendment, Leo One increases its service downlink bandwidth from 35 to 55 kHz. *See id.* at 4. Leo One's October 29, 1997 amendment also significantly increases its satellite's

[33] Leo One states that the increase in orbital planes is necessary to ". . . insur[e] that service availability and system efficiency increases." Leo One Second Amendment at 2.

onboard propulsion capability, adding a requirement for more power in order to move the satellites from a parking orbit into final orbit. *See id.* at ¶ 24.

Furthermore, Leo One requests WRC-95 spectrum in its October 29, 1997 Amendment, although these frequencies are not contemplated within the System 1 assignment for Leo One under the Joint Proposal and the *Report and Order*.[34] This request for WRC-95 spectrum, like Starsys's request for additional spectrum in the *Starsys* case, constitutes a major amendment because it would increase frequency conflicts and is not contemplated by the band-sharing plan.[35]

Final Analysis does not here suggest that Leo One be excluded from the processing round on the basis of its System 1 design. Rather, Final Analysis supports the implementation of the band plan in the Joint Proposal and the *Report and Order* and the

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[34] Furthermore, as pointed out in Final Analysis's December 4, 1997 comments on Leo One's amendment, Leo One has proposed the addition of a V-band payload to its Little Leo constellation. The V-band amendment would constitute a change in frequencies and have a direct impact on Final Analysis, which needs additional future spectrum to complete its system.

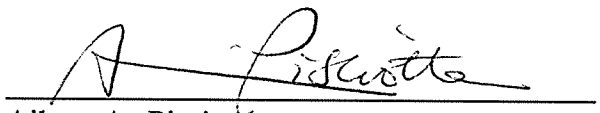
[35]Each of these amendments as well as significant Air Force time-sharing requirements imposed on System 1 by the *Report and Order* substantially increase Leo One's system costs. *See*, Final Analysis Amendment, p. 10, note 14. yet Leo One has not demonstrated whether they are technically or economically justifiable. Final Analysis also notes that Leo One has never identified critical technical characteristics of its system design. Leo One stated in its original application that it would not design, build or launch its satellites, but would issue a "request for proposal" ("RFP") to rely on outside contractors. Unlike other first and second round Little LEO applicants, as well as Big LEO applicant, however, Leo One has never identified contractors for the design and construction of its satellites (including power system, onboard propulsion, altitude control systems, solar panel arrays, flight radios, etc.). Leo One also has not identified a contractor that will build its satellites. Leo One also has not identified launch service providers or its contractor arrangements for ground station construction or customer terminal infrastructure. Accordingly, the Leo One has woefully failed to submit sufficient information for the Commission to find that it is technically qualified to receive an NVNG MSS license.

licensing of all qualified applicants subject to coordination. Final Analysis merely points out that the standard applied by the Commission regarding the status of amendments must be consistent across the board. On this basis, Final Analysis's Amendment should be accepted.

CONCLUSION

For the reasons stated, Final Analysis urges the Commission to dismiss Leo One's Petition to Deny the above captioned amendment and to grant a license to Final Analysis for Little Leo System 2 in accordance with its amended system application.

FINAL ANALYSIS COMMUNICATION SERVICES, INC.

By: 

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Dated: December 15, 1997

APPENDIX A

A PROBABILITY STUDY OF THE EFFECT ON POTENTIAL INTERFERENCE TO NOAA SATELLITES FROM THE MODIFICATION TO THE FAISAT CONSTELLATION DESIGN

FINAL ANALYSIS

A Probability Study of the Effect on Potential Interference to NOAA Satellites from the Modification to the FAISAT Constellation Design

Final Analysis has been allocated downlink spectrum in the 137-138 MHz band on a time-shared, non-interference basis with NOAA. In order to conform with the Report and Order, the following goals were established:

1. Recover lost system availability due to time-sharing by increasing the number of operational satellites.

2. Minimize any potential increase in interference with NOAA of the modified constellation design.

Interference only occurs when a Final Analysis satellite (FAISAT) is transmitting in a frequency band actively being used by a NOAA satellite and its ground footprint is overlapping the ground footprint of the NOAA satellite (both conditions must be met for interference to occur). The FAISAT constellation design affects the number of ground footprint overlaps (the second condition for interference). Final Analysis completed a probability study which shows that a modified constellation design incorporating 32 operational FAISATs can be implemented without increasing the effective number of ground footprint overlaps.

Probability distributions of ground footprint overlaps (at zero degree elevation angles) were calculated for a 24 hour period by modeling the current NOAA-14 satellite versus the two FAISAT constellation designs:

> The original design included 26 operational satellites placed in four primary planes of six satellites each inclined at 66 degrees and two supplementary planes of one satellite each inclined at 83 degrees. The four primary planes were arranged asymmetrically, as originally proposed.
>
> The modified design includes 32 operational satellites placed in six primary planes of five satellites each inclined at 51 degrees and two supplementary planes of one satellite each inclined at 83 degrees. The six primary planes were arranged symmetrically. The altitude was left unchanged at 1000 km.

The modifications to the FAISAT constellation design increased the mean number of satellites in overlap by only one (from 7 to 8) which is offset by the fact that the standard

deviation decreased by one (from 2 to 1). The mean and standard deviation taken in combination remained constant at 9 showing that there is no increase in the effective number of ground footprint overlaps (see Figure 1). Figure 1 also shows that a meteorological satellite system required to time-share frequencies with FAISAT will always experience less potential interference than a system required to time-share with LEO-ONE.

Figure 1 summarizes the statistics of ground footprint overlaps for the various constellation designs. Figure 2 shows the probability distribution for the original FAISAT constellation design of 26 satellites. Figure 3 shows the probability distribution for a 32 satellite constellation design including six primary planes of five satellites each inclined at 66 degrees and arranged symmetrically. This design resulted in a larger effective number of ground footprint overlaps and was discarded. However, the design incorporated a larger number of operational satellites without increasing the standard deviation of ground footprint overlaps due to the symmetric arrangement of planes which changed the distribution type from bimodal (two peaks) to unimodal (one peak). NOAA satellites are placed in sun-synchronous orbits of high inclination and lowering the orbital inclination of the 32 satellite constellation design from 66 to 51 degrees decreases the mean and standard deviation of ground footprint overlaps (see Figure 4). Therefore all the modifications made to the FAISAT constellation design (the symmetric arrangement of planes and lowered inclination) are required in combination to allow an increase in operational satellites (from 26 to 32) with no increase in the effective number of footprint overlaps. Finally, Figure 5 shows the much larger potential for interference from the 48 satellite constellation design of LEO-ONE.

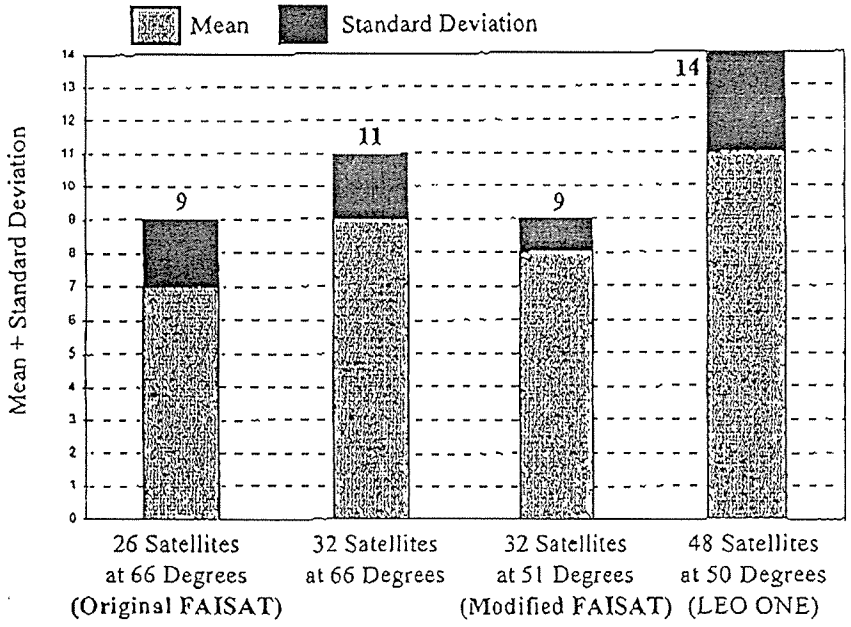


Figure 1: Comparison of Effective Number of Ground Footprint Overlaps for various Constellation Designs

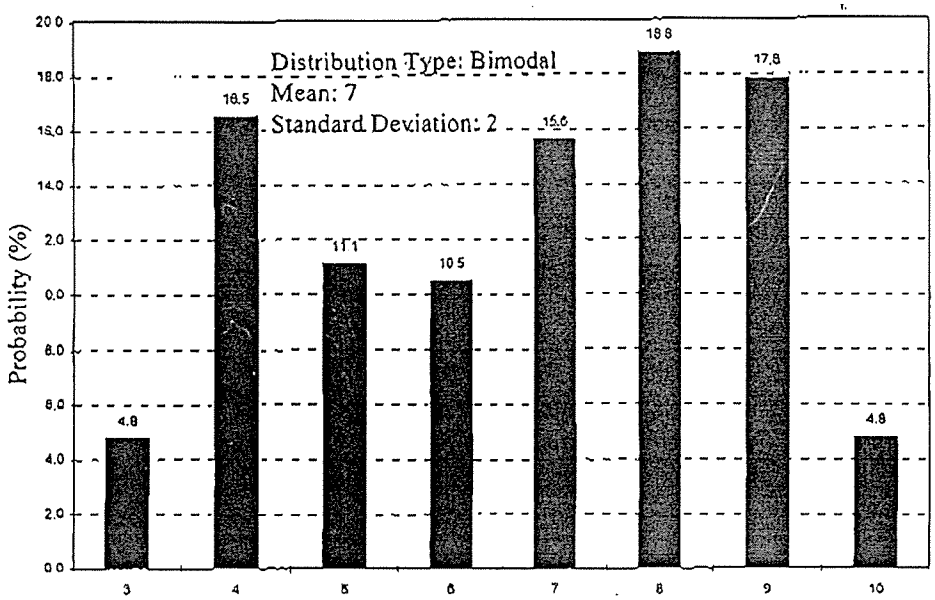


Figure 2: Probability Distribution for 26 Satellite Constellation Inclined 66 Degrees (Original FAISAT Constellation Design)

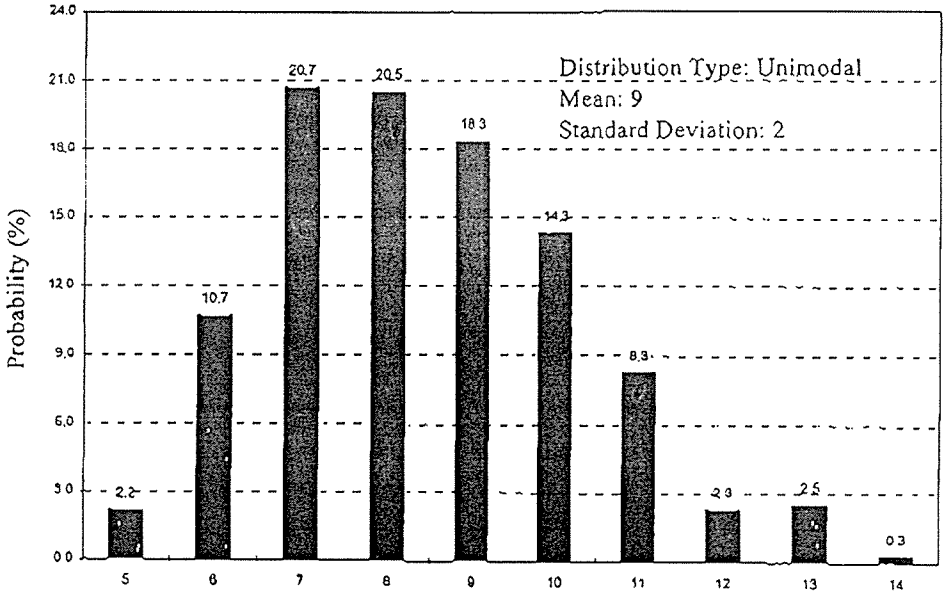


Figure 3: Probability Distribution for 32 Satellite Constellation Inclined 66 Degrees

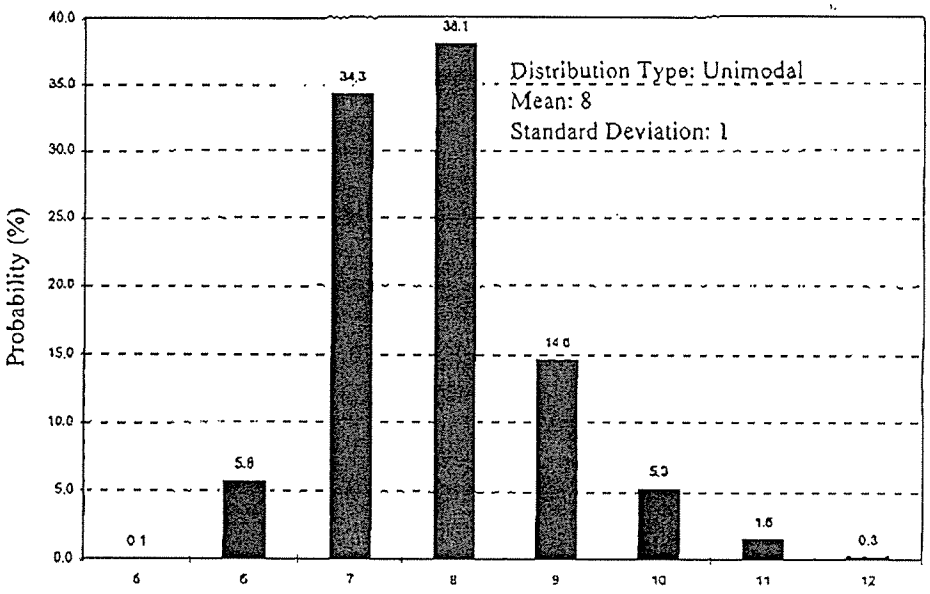


Figure 4: Probability Distribution for 32 Satellite Constellation Inclined 51 Degrees (Modified FAISAT Constellation Design)

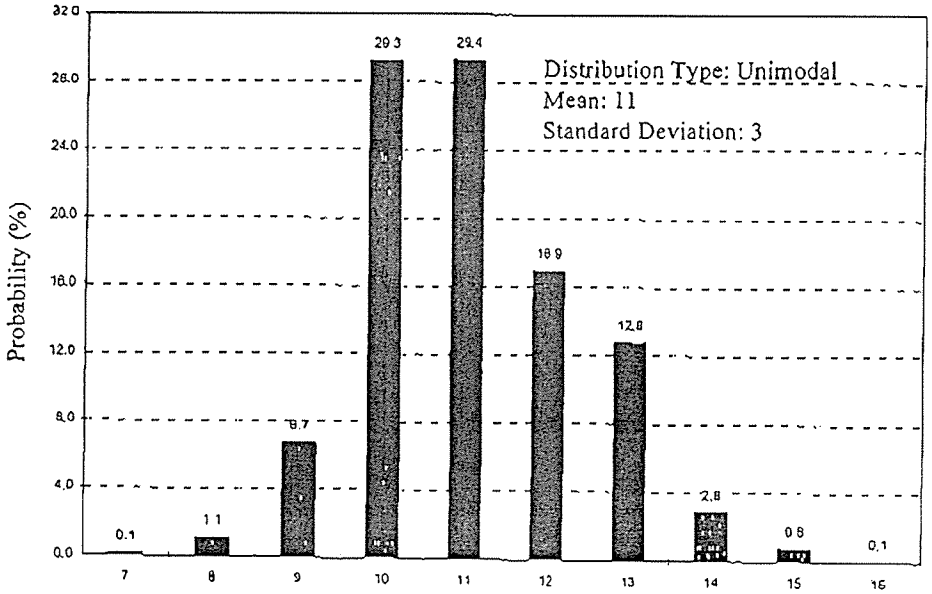


Figure 5: Probability Distribution for 48 Satellite Constellation Inclined 50 Degrees (LEO-ONE Constellation Design)

APPENDIX B

ADJACENT CHANNEL OUT-OF-BAND EMISSION STUDY

Adjacent Channel Out of Band Emission Study

1. Introduction

Over the past several years Final Analysis has devoted significant time and resources in the development of GMSK modulation practices which were ultimately implemented and tested in the FAISAT-1 and FAISAT2v experimental satellites. The result of our R&D demonstrated that GMSK was by far the superior technology to minimize out of band interference.

Final Analysis has performed analysis, laboratory demonstrations in conjunction with Texas A&M University, laboratory demonstrations at Final Analysis, and measurements of actual flight hardware and subscriber terminals transmitters in order to determine out of band emissions of transmitters using GMSK modulation with a BT=.5. Final Analysis has found that all laboratory demonstrations and measurement of flight hardware have yielded results close to the theoretical calculations which have been performed.

This paper first provides a brief definition of adjacent channel interference used by the U.S. digital cellular Industry (IS-54). This definition is then applied to the Final Analysis system and the results compared with the IS-54 specification for suppression of emissions in the first adjacent band. Without additional information from Little LEO systems that have adjacent frequency assignments, these standards are considered to be a close first order approximation sufficient to demonstrate the feasibility of coordination with other users of the band who are assumed to use a signal-in-space very similar to that used by the U.S. digital cellular FDMA systems.

2. Definition of Adjacent Channel Interference

Adjacent Channel Interference (ACI) is defined as follows:

$$ACI := \frac{\int_{-\infty}^{\infty} G(f)\cdot(|H(f-\Delta f)|)^2\,df}{\int_{-\infty}^{\infty} G(f)\cdot(|H(f)|)^2\,df}$$

Where G(f) is the Power Spectral Density (PSD) of the signal, H(f) is the receive band-pass filter (BPF) transfer function, and Δf is the carrier spacing between adjacent channels.

3. U.S. Cellular Industry Standard (IS-54) Definition and Specification of Adjacent Channel Interference

The receive band-pass filter is assumed to be a 25 kHz brick wall filter. This definition is consistent with the U.S. digital cellular (IS-54) system with the exception that this standard uses a receive bandwidth of 30 kHz. In this standard the first channel ACI is specified to be -26[1] dB below the desired carrier power in a 30 kHz bandwidth. In a 25 kHz bandwidth the equivalent power would be -25.2 dB below the desired carrier power.

4. Power Spectral Density of the Final Analysis Transmitters

Figure I, labeled "GMSK Normalized PFD" shows the PFD of the FAISAT transmitter normalized to the transmission rate. The modulation parameters are as follows:

a. Gaussian Minimum Shift Keying
b. BT=.5
c. Non Linear Amplifier (Hard Limited Channel)

GMSK modulation has a constant power envelope and as such may be amplified by a non-linear power amplifier with minimal spectral re-growth.

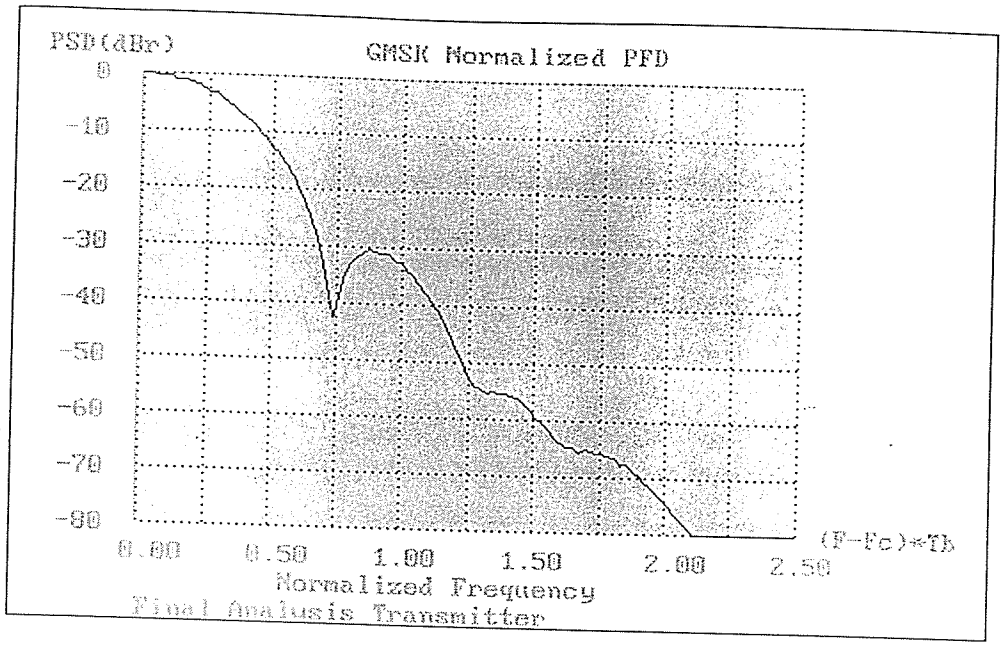
It is important to note that the chart is normalized to zero and shows the roll-off relative to the center PFD as a function of frequency offset from carrier center. The power flux density at the center frequency is reduced from total carrier power and is a function of the type and rate of modulation. For GMSK (BT=.5) the relationship to carrier power and carrier power flux density in a 4 kHz bandwidth at carrier center is as follows:

a. Bit Rate = 96,000 bps, Carrier PFD/4 kHz = Carrier Power -11 dB
b. Bit Rate = 19,200 bps, Carrier PFD/4 kHz = Carrier Power -4 dB

The above results are based on generated direct measurement of a simulated downlink signal by laboratory simulation using a variety of state-of-the-art equipment including an Arbitrary Waveform Generator and a Vector Signal Analyzer.

[1] Feher, Kamilo - "Wireless Digital Communications", 1995, Prentice Hall, Inc.

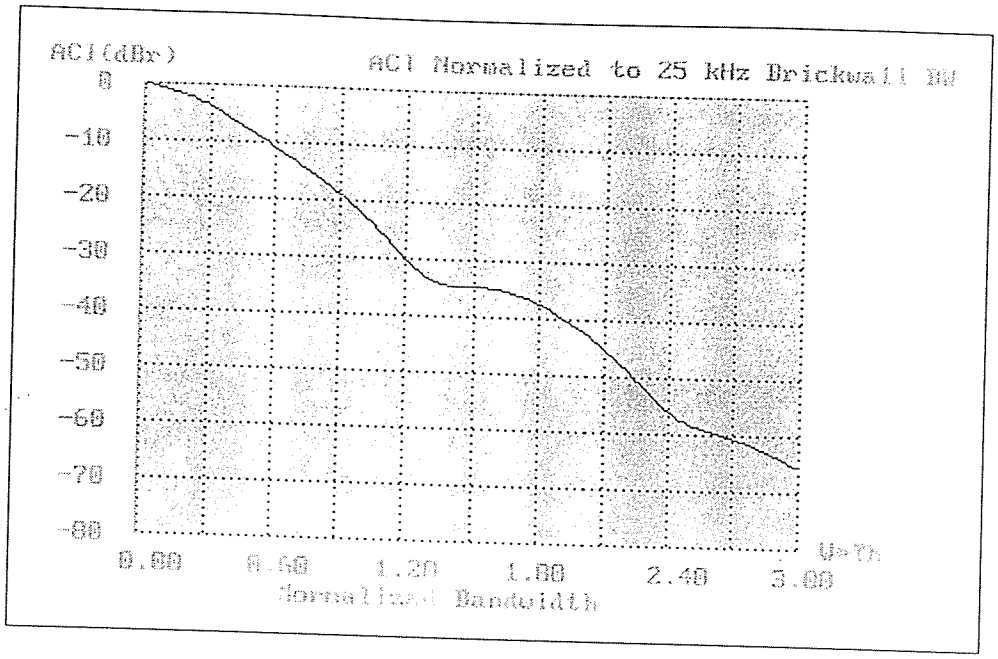
GMSK Normalized Power Flux Density



5. Adjacent Channel Interference from Final Analysis Transmitters

The chart labeled "ACI Normalized to 25 kHz Bandwidths Brick-wall BW shows the Adjacent Channel Interference that would be received by a receiver with a receive bandwidth of 25 kHz and a brick-wall band-pass shape.

ACI in a 25 kHz Bandwidth
Frequency Normalized to Baud Rate



The ACI was calculated for the following specific cases (normalized to PFD at carrier center):

1. Final Analysis transmitter at 137.1 MHz
   Transmitter Doppler shift = -2896 Hz
   Transmitter Frequency Error = -274 Hz
   GMSK Modulation (BT=.5, 96,000 bps)
   Victim Receiver Frequency = 137.0125 MHz
   Victim Receiver bandwidth = 25 kHz (Brick-wall)

2. Final Analysis transmitter at 400.52835 MHz
   Transmitter Doppler shift = -8478 Hz
   Transmitter Frequency Error = -800 Hz
   GMSM Modulation (BT=.5, 19,200 Hz)
   Victim Receiver at 400.4925 MHz
   Victim Receiver bandwidth = 25 kHz (Brick-wall)

For case 1, the PFD roll-off normalized to the PFD at carrier center is -35 dB.

For case 2, the PFD roll-off normalized to the PFD at carrier center is -36 dB.

These cases can be considered to be representative of all channels in the two bands of interest.

4. Conclusion

As stated in Section 3 of this report the U.S. cellular industry finds acceptable out of band emissions less than 25.2 dB below the carrier power in a 25 kHz channel. As indicated in Fig. II, the Final Analysis system out of band emission in the 137 and 400 band are 35 dB and 36 dB respectively below carrier power, a value well within the coordination capabilities of the parties.

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing "**OPPOSITION TO PETITION TO DENY**" of Final Analysis Communication Services, Inc. was sent by hand delivery or mailed, via first-class mail, postage prepaid, this 15th day of December, 1997, to each of the following:

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