BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

In the matter of the Application of	)	
	)	
STARSYS, INC.	)	File No. 33-DSS-P-90(24)
	)	
For Authority to Construct a System of Low Earth Orbit Communications Satellites to be Stationed in an Inclined Non-Geostationary Orbit	)	

To: The Commission

REPLY COMMENTS OF STARSYS, INC.

Raul R. Rodriguez
Stephen D. Baruch

Leventhal, Senter & Lerman
2000 K Street, N.W.
Suite 600
Washington, D.C. 20006-1809
(202) 429-8970

Attorneys for STARSYS, Inc.

September 4, 1990

TABLE OF CONTENTS

SUMMARY

In these Reply Comments, STARSYS, Inc. ("STARSYS") responds to the twelve commenters that filed comments on STARSYS's application to establish a low earth orbit ("LEO") mobile satellite service ("MSS") system consisting of 24 in-orbit component spacecraft and 2 ground spares.

Nine of the commenters, along with a number of the parties commenting on STARSYS's related petition for rule making to establish the LEO MSS service, were extremely enthusiastic about various service attributes of STARSYS's system. All strongly advocated the prompt grant of STARSYS's application.

STARSYS also responds to the comments filed by Communications Satellite Corporation and Geostar Corporation. These commenters addressed certain regulatory and technical aspects of STARSYS's proposal, but did not object to the grant of STARSYS's application.

Finally, STARSYS responds to the petition to deny that was filed by Orbital Communications Corporation ("Orbcomm"). It shows that there is no basis whatsoever, in fact or in law, for Orbcomm's assertion that the Commission should treat STARSYS as a common carrier and therefore deny its application as violative of the foreign ownership limitations contained in Section 310(b) of the Communications Act of 1934. STARSYS's proposal to offer its system's capacity for sale on a noncommon

carrier basis is fully consistent with longstanding Commission precedent. Transponder Sales Order, 90 F.C.C.2d 1238 (1982) (subsequent history omitted). Moreover, STARSYS's ownership structure is fully consistent with Section 310(a) of the Communications Act of 1934, as amended, and with Commission interpretations thereof. ST Systems Corporation, a long-established corporation with many years of relevant experience, has been involved with STARSYS since its formation and is in full control of the applicant and application process.

STARSYS also shows that Orbcomm's attempt to disqualify STARSYS on technical grounds is both procedurally and substantively flawed. As for Orbcomm's objections to STARSYS's financial showing, STARSYS notes that it has supplied information necessary to meet the "first stage" showing that the Commission has applied in recent years to new satellite services applicants, and that it has offered to supply whatever additional information the Commission may require.

In sum, STARSYS is fully qualified to construct its proposed system. It urges the Commission to heed the desires and comments of the overwhelming majority of commenters, and conclude that the prompt grant of STARSYS's proposed LEO MSS system application is required in the public interest.

BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

In the matter of the Application of	)	
	)	
STARSYS, INC.	)	File No. 33-DSS-P-90(24)
	)	
For Authority to Construct a System of Low Earth Orbit Communications Satellites to be Stationed in an Inclined Non-Geostationary Orbit	)	

To: The Commission

REPLY COMMENTS OF STARSYS, INC.

STARSYS, Inc. ("STARSYS"), by its attorneys, hereby replies to the comments filed in response to its above-captioned application for authority to construct a low Earth orbit ("LEO") mobile satellite service ("MSS") system.

I. INTRODUCTION

The STARSYS LEO MSS system will consist of twenty-four in-orbit LEO MSS component spacecraft and two ground spares. The operational component spacecraft will be placed into circular orbits approximately 1,300 kilometers above the earth. The system will be capable of providing twenty-four hour two-way communications and position determination services via ultra-low-cost user terminals.

The STARSYS system will be used to provide a wide variety of communications services tailored to meet the requirements of such users as the automotive, fishing, trucking, environmental control, health care, and leisure industries, as well as particularized needs within the scientific and medical communities. Capacity on the STARSYS system will be sold or leased to service providers within the various market segments on a non-common carrier basis. STARSYS will not be providing services directly to end-users.

With the sole exception of putative LEO MSS operator Orbital Communications Corporation ("Orbcomm"),[1/] there was unanimous support for the grant of STARSYS's application and the service and public interest benefits that will follow therefrom. Representatives from the Government and a variety of industries weighed in with their endorsements of STARSYS's revolutionary proposal to bring low-cost, universally-available

---

1/ Orbcomm has applied for authority to construct an LEO MSS system in the same frequency bands as STARSYS. Orbcomm proposes to employ frequency division multiple access (i.e., non-spread spectrum) technology -- a spectrum-sharing approach, based on interstitial spacing with existing users of the bands, that effectively limits the number of LEO MSS services in the band to one. Moreover, Orbcomm has refused to amend its application to specify spectrum-efficient and pro-competitive spread spectrum modulation techniques. Orbcomm clearly is attempting to secure exclusive access to the requested frequency bands, and its comments in this proceeding should be viewed as nothing more than a self-interested effort to bar STARSYS's proposed entry.

mobile communications services into operation. Indeed, of the twelve parties filing comments in response to STARSYS's application, nine represented potential purchasers or users of STARSYS's capacity that expressed interest in various capabilities of the STARSYS system.

STARSYS appreciates this showing of support, and urges the Commission to heed these comments and grant STARSYS's application. In the discussion below, STARSYS addresses the positive expressions of interest that were filed and responds to the substantive matters addressed in the comments of Communications Satellite Corporation ("COMSAT"), Geostar Corporation ("Geostar"), and Orbcomm. As noted, only Orbcomm, which desires to obtain exclusive LEO MSS access to the frequencies for which STARSYS has applied, interposed any objections to the grant of STARSYS's application.[2/]

2/ Orbcomm states that it "welcomes competition, so long as the additional service providers are qualified, and do not interfere with Orbcomm or operate in different spectrum." Orbcomm Comments at 2. Since the technically inferior and spectrum-inefficient Orbcomm proposal ensures that no other LEO MSS system will be able to operate in the requested frequency bands, Orbcomm's highly conditional welcoming of competition is nothing more than a restatement of its demand for exclusive access to the LEO MSS frequencies.

II. DISCUSSION

A. The Comments Reveal That There Are Likely To Be A Wide Variety Of Potential Service Offerings Made Via The STARSYS LEO MSS System.

Of the twelve parties filing comments in response to STARSYS's application, nine -- namely, KPMG Peat Marwick; National Oceanic and Atmospheric Administration; Ecosystems International, Inc.; Battelle; Vaudrey & Associates, Inc.; Oceanweather, Inc.; LTM Corporation of America; Houston Data Transmission Co., Inc.; and English Automotive, Ltd. -- represent potential users and providers of LEO MSS services via the STARSYS system. Only Communications Satellite Corporation, Geostar Corporation, and Orbcomm did not express an interest in the service applications possible with the STARSYS LEO MSS system. (These comments are discussed in Sections II.B and II.C, infra.)

Other potential STARSYS system users included comments supportive of STARSYS's proposed LEO MSS system in their filings in support of STARSYS's concurrently-filed petition for rule making to allocate spectrum for STARSYS's proposed LEO MSS and establish rules to govern the provision of service. These parties include the College of Oceanography at Oregon State University; the Polar Science Center, Applied Physics Laboratory, College of Ocean and Fishery Sciences, University

of Washington; the Volunteer Observing Ship Program at Scripps Institution of Oceanography; Natural Resources Consultants, Inc.; Southwest Research Institute; MicroSat Launch Systems, Inc.; and the Inter-American Tropical Tuna Commission. See STARSYS Reply Comments in RM-7399 at 2-3. STARSYS asks that these comments be incorporated by reference into this proceeding. (Copies of the relevant comments are attached hereto as Appendix A.)

The nine parties that expressed interest in STARSYS LEO MSS services, along with those parties who made similar expressions of interest in response to STARSYS's related petition for rule making, represent a broad cross-section of government and industry. They demonstrate the virtually unlimited potential for the LEO MSS system proposed in STARSYS's application.

From their comments, it appears that some of these commenters would be interested in purchasing STARSYS capacity for the provision of services to their clients. For example, KPMG Peat Marwick is interested in using STARSYS to provide shipping and inventory control services to its clientele, and Oceanweather, Inc., expressed interest in using STARSYS to provide weather data to its clients. Others appear to be interested in the capabilities of STARSYS's system as an aid in keeping track of their own inventories and equipment. Thus,

LTM Corporation of America, a supplier of rental equipment and location services to motion picture and non-broadcast video companies, projected that the STARSYS system could enable it to establish a property-tracking system that would permit expansion of its customer base and improvements in billing practices.

The LEO MSS system proposed by STARSYS is designed to be flexible enough to accommodate a virtually unlimited number of potential applications. These potential applications include all of the service variants described or suggested by the commenters, and countless others that have yet to be conceived. Because STARSYS is proposing to sell capacity on a non-common carrier basis, it is able to engage in the type of long-term contractual relationships with its customers that traditionally have been designed to ensure maximum service innovation and stability of relations. See Domestic Fixed-Satellite Transponder Sales, 90 F.C.C.2d 1238 (1982) ("Transponder Sales").

The diversity of particularized technical and service interests and requirements expressed in the comments only reinforces STARSYS's decision, as embodied in its application, that it can better serve its own customers by entering into long-term customer-specific relationships, rather than by trying to establish tariffs that comprise all possible service

options. Indeed, STARSYS believes that the latter course of action would, for a new and commercially untested service such as the LEO MSS, be an inherently confining and ultimately dysfunctional exercise.

B. The Issues Raised By COMSAT And Geostar, Who Do Not Oppose The Grant Of STARSYS's Application, Can Be Resolved Without Requiring The Delay Or Denial Of The STARSYS System Proposal.

1. Response To COMSAT Comments

In its comments, COMSAT stated that it does not oppose the grant of STARSYS's application. Instead, COMSAT merely expressed its belief that "to the extent that STARSYS provides international communications services, we submit that STARSYS would be subject to the same policies and conditions as apply to U.S. separate systems." COMSAT Comments at 1 (citation omitted). COMSAT also opined that STARSYS would be subject to the notification procedures of Article 8 of the International Maritime Satellite Organization Convention to the extent that international maritime services are offered. Id. at 1-2.

STARSYS hereby states that it will comply with whatever regulatory conditions the Commission properly imposes upon the operation of its system. Should these requirements include a determination that STARSYS must coordinate its system with the global system of the International Telecommunications

Satellite Organization ("INTELSAT") pursuant to Article XIV(d) of the INTELSAT Agreement, STARSYS will comply with this requirement (even though it seems doubtful that a low Earth orbit mobile satellite system that is incapable of voice operations could conflict in any way with the global fixed-satellite service system of INTELSAT).

With regard to COMSAT's suggestion that the U.S. separate systems restrictions should apply to STARSYS's system, STARSYS makes two observations: First, the appropriate place for such a suggestion is in the parallel rulemaking proceeding, not in connection with an individual system application. In its Separate Systems proceeding, the Commission promulgated the requirements with which COMSAT is concerned in the rulemaking proceeding, and merely applied the requirements as conditions in the parallel system authorization proceedings. See Establishment of Satellite Systems Providing International Communications, 101 F.C.C.2d 1046 (1985) ("Separate Systems") (subsequent history omitted). See also Pan American Satellite Corporation, 101 F.C.C.2d 1318, 1337 (1985) (subsequent history omitted). COMSAT will have an opportunity to reassert its suggestion in response to the notice of proposed rule making that presumably will ensue from STARSYS's petition.

Second, and irrespective of the procedural propriety of its argument in this application proceeding, COMSAT

overlooks the fact that STARSYS has filed a domestic satellite system application. The Commission has determined that transborder (or incidental) international communications services may be provided by domestic satellite operators -- subject to coordination under Article XIV(d) of the INTELSAT Agreement -- without regard to the Commission's restrictions on the operations of the U.S. separate international satellite systems. Transborder Satellite Video Services, 88 F.C.C.2d 258 (1981). To the extent that COMSAT argues that even transborder services via STARSYS's system should be subject to the separate systems requirements, its assertions should be rejected outright.

2. Response To Geostar Comments

Like COMSAT, Geostar Corporation ("Geostar") does not object to STARSYS's application. Indeed, unlike Orbcomm, Geostar appears to invite the competition that STARSYS poses to its mobile and radiodetermination satellite ventures. In this vein, and in the spirit of healthy competition, Geostar proceeds to address the particulars of several STARSYS claims as to the technical attributes of its system. Geostar Comments at 3-5.

Most of the technical matters raised by Geostar (e.g., system efficiency and capacity matters) are related to the

spread spectrum component of STARSYS's proposal. These matters have been addressed in STARSYS's reply comments in the parallel rulemaking proceeding, and the Technical Statement of Wilbur Pritchard and Marvin Senter that STARSYS submitted therewith. (A copy of the STARSYS Technical Statement, including an erratum thereto that will be filed separately with the Commission, is attached hereto as Appendix B.) Other matters are addressed in the Technical Statement that is attached hereto as Appendix C.

Geostar's suggested clarifications are provided in Appendices B and C to these reply comments. There, STARSYS demonstrates that spread spectrum technology is not only feasible for the LEO MSS, it is far superior to an LEO MSS system based on frequency division multiple access. STARSYS also responds to comments addressing the orbital deployment plan and its reliance on polled access, showing that concerns raised are unfounded or exaggerated.

In short, the matters addressed in the COMSAT and Geostar comments do not require delay of the processing of STARSYS's application, and neither party opposes the grant of STARSYS's proposal in due course. The comments filed by COMSAT and Geostar should not form the basis of a decision to delay or deny STARSYS's application.

C. Orbcomm's Petition To Deny STARSYS's Application Is Procedurally And Substantively Flawed.

Orbcomm, which has applied for authority to construct an LEO MSS system with exclusive access to the same frequencies where STARSYS now seeks to establish a pro-competitive LEO MSS system, petitioned to deny STARSYS's application. Though its filing was styled as comments, there can be no doubt that Orbcomm's desire to have STARSYS's application denied on grounds that STARSYS is not legally, technically, and financially qualified to be a Commission LEO MSS system licensee, renders Orbcomm a petitioner to deny.

Orbcomm's legal qualifications argument is convoluted, flatly wrong, and calculated only to confuse the issues in this proceeding. STARSYS clearly has applied for authority to provide LEO MSS services on a non-common carrier basis. It provided a full justification for this posture -- complete with citations to a decade of relevant Commission and judicial decisionmaking precedent. See STARSYS Application at Section IV.

Orbcomm, however, relying entirely on strained misinterpretations of a handful of Commission and court decisions, engages in a dilatory and confusing attempt to cast STARSYS as something it is not and does not want to be. Orbcomm asserts that the Commission should disregard STARSYS's

proposal to provide LEO MSS capacity on a non-common carrier basis to its customers (who would then offer services to their end-user customers) and find, sua sponte, that STARSYS is a common carrier. Orbcomm's transparent attempt to clothe STARSYS in the garb of common carriage is made only for the simple reason that the Communications Act does not forbid alien ownership or control of a non-common carrier satellite system (so long as representatives of foreign governments do not control the licensee), whereas aliens are generally prohibited from owning majority interests (controlling or not) in common carrier radio station licensees. See 47 U.S.C. §§ 310(a) and (b).

Orbcomm asserts that because ninety-five percent of the equity of STARSYS is owned by aliens, if STARSYS were a "common carrier," it would run afoul of the alien ownership limitations of Section 310(b) of the Communications Act of 1934, as amended. Accordingly, argues Orbcomm, STARSYS must be ruled to be unqualified to be a Commission licensee.

Orbcomm's entire legal argument is premised on a straw man -- i.e., Orbcomm's claim that STARSYS is under some form of legal compulsion to be a common carrier. If this assertion is untrue or incorrect, the entire syllogism that Orbcomm has premised upon this claim must fall of its own weight. STARSYS shows below that Orbcomm's legal analysis is facile and

fundamentally flawed. The claim appears to have been interposed by Orbcomm solely for purposes of delay and obfuscation. STARSYS is fully competent to become a non-common carrier licensee of its proposed LEO MSS system.

1. STARSYS Is Under No Legal Obligation To Be A Common Carrier Provider Of LEO MSS Services, And Thus Section 310(b) Of The Communications Act Is Inapplicable.

According to Orbcomm, when the definition of common carriage propounded in National Association of Regulatory Utility Commissioners v. FCC, 525 F.2d 630, 642 (D.C. Cir. 1976) ("NARUC I") is applied to STARSYS's proposal to sell or lease capacity on its system on a non-common carrier basis, the Commission must conclude that STARSYS is a common carrier. Orbcomm Comments at 5-7. This is preposterous.

In its Transponder Sales decision, a directly relevant -- indeed controlling -- case that is conspicuously absent from Orbcomm's "analysis," the Commission construed the court's NARUC I decision in the context of transponder sales. Applying the NARUC I test, the Commission found that "the nature of transponder service is not such that it would be expected to be provided uniformly and indiscriminately to all potential customers on a common carrier basis." Transponder Sales, 90 F.C.C.2d at 1256. The Commission concluded that:

> [O]ur review of the record indicates little likelihood that noncommon carrier domsats will hold themselves out indifferently to serve the user public. Stable, long-term contractual offerings to individual customers of technically and operationally distinct portions of a satellite system fall far short of the indiscriminate holding out contemplated in the NARUC I decision. Having found no legal compulsion to serve indifferently, nor significant reasons implicit in the nature of transponder sales to expect an indifferent holding out to the eligible user public, we reaffirm that qualified persons may apply for domestic satellite licenses for noncommon carrier purposes.

Transponder Sales, 90 F.C.C.2d at 1257.[3/]

The Commission's Transponder Sales decision, which was subsequently upheld by the court of appeals in Wold Communications, Inc. v. FCC, 735 F.2d 1465 (D.C. Cir. 1984), put an end to the sort of ad hoc evaluation of the nature of a proposed service offering that Orbcomm advocates in its comments. Orbcomm Comments at 5. A recent Common Carrier Bureau decision describes the legal import of the Transponder Sales decision as follows: "The Commission previously found in its Transponder Sales decision that the sale or long-term lease of domestic satellite transponders by satellite owners does not

---

3/ Insofar as STARSYS's proposed satellites do not have "transponders" per se, STARSYS has proposed to sell discrete units of capacity in its LEO MSS system in "Million Transmission" units. The operative and bulk sale features of the STARSYS LEO MSS system Million Transmission units are functionally identical to transponders.

constitute common carrier activity." Pacific Telecom Cable, Inc., 2 FCC Rcd 2686, 2687 (Common Carr. Bur. 1987).[4/]

In advancing its claim that STARSYS cannot unilaterally determine that it will offer satellite capacity on its system on a non-common carrier basis, Orbcomm has misleadingly commingled the Commission's decisions regarding

---

4/ Curiously, the Pacific Telecom Cable decision was cited by Orbcomm. See Orbcomm Comments at 5 n.10. Neither this decision, nor the Common Carrier Bureau's decision in Satellite Transmission and Reception Specialist Company, 5 FCC Rcd 4131 (Common Carr. Bur. 1990) ("STARS"), provide any support for Orbcomm's claim that STARSYS is to be treated as a common carrier. In STARS, the Bureau held that the operator of an international earth station that provides access to INTELSAT for the provision of services to the public is statutorily obligated to be a common carrier where the station would be operationally connected with, and an integral part of, the operator's common carrier network. Id. at 4133 (citing Sections 103(2) and 201(c)(7) of the Communications Satellite Act of 1962, as amended, 47 U.S.C. §§ 702(2) and 721(c)(7)). No such legal compulsion exists with regard to STARSYS's "transponder" sales proposal, since neither INTELSAT space segment nor earth station services apply to the STARSYS proposal, and thus the Communications Satellite Act of 1962 is not implicated. Also misplaced is Orbcomm's reliance on Transnational Telecom, Ltd., 5 FCC Rcd 598, 599 (Common Carr. Bur. 1990), for the proposition that STARSYS cannot designate itself to be a non-common carrier provider of LEO MSS satellite capacity. See Orbcomm Comments at 5 & n.11. Transnational Telecom is a transpacific cable decision that not only has no connection to the point argued by Orbcomm, it stands for the proposition that STARSYS is not a common carrier. As in Pacific Telecom, the Bureau stated in Transnational Telecom that: "[t]he Commission previously found in its Transponder Sales decision that the sale or long-term lease of domestic satellite transponders by satellite owners does not constitute common carrier activity." 5 FCC Rcd at 599 (footnote omitted).

the non-common carrier nature of transponder sales with the separate but related question of whether authorizing the creation of additional non-common carrier satellite capacity is consistent with the public interest. See Orbcomm Comments at 6. When the Commission first decided to authorize the sale of transponder capacity on a non-common carrier basis, it was concerned that there would be an abandonment of common carrier transponder capacity (e.g., by established common carriers such as Western Union), and pledged to monitor the progress and prevalence of transponder sales, and require satellite operators to submit information sufficient to enable the Commission to determine whether establishment of additional non-common carrier capacity would jeopardize the availability of common carrier capacity. A negative answer to this question could, suggested the Commission, lead to a determination that the authorization of particular transponder sales proposals would not be in the public interest; it would not, contrary to Orbcomm's bizarre suggestion, mandate a determination that the subject satellite operator was a common carrier.

In any event, less than five years after the Transponder Sales decision, the Commission determined that there had not been a wholesale abandonment of the offering of transponders on a common carrier basis, as some had feared. Accordingly, in Martin Marietta Communications Systems, Inc.,

60 R.R.2d 779 (1986), the Commission stated that "domestic satellite licensees should be routinely authorized to offer transponders on a noncommon carrier basis absent a showing that it would not be in the public interest by a petitioner." Id. at 783 (footnote omitted). The burden of proving that a particular transponder sales proposal was not in the public interest was placed squarely upon the opposing party, and the Commission specifically stated that it "will require that petitions to deny set forth clearly and concisely the facts relied upon, the relief sought, the statutory and/or regulatory provisions (if any) pursuant to which the request is filed and under which relief is sought, and the interest of the person submitting the request." Id. at 783 n.11 (citation omitted).

Here, Orbcomm has clearly failed to meet its heavy burden of proving that STARSYS's non-common carrier LEO MSS proposal is not in the public interest. First of all, Orbcomm proposes to offer all of its LEO MSS system capacity on a common carrier basis. Thus, LEO MSS capacity will be offered on the common carrier basis by Orbcomm, and possibly others. Orbcomm makes no showing that this is insufficient to serve the public; indeed, until now, no common carrier capacity for these services has been available at all. Accordingly, grant of STARSYS's non-common carrier proposal clearly will not adversely affect the public interest.

In addition, there is no merit to Orbcomm's claim that STARSYS should not be allowed to operate on a non-common carrier basis because some of its customers, who may contemplate providing some "critical emergency services" to their own end-users, may not have purchased sufficient capacity "to last throughout the end of the year" and thus risk being cut off by STARSYS. Orbcomm Comments at 6. Orbcomm's speculative assertion, that a non-common carrier is somehow prohibited from offering additional capacity to a municipality or a hospital (or anyone else) who may have a need for "emergency capacity" in excess of the amount initially contracted for, is a ludicrous proposition unaccompanied by any supporting regulatory justification.

Finally, Orbcomm's attempt to identify inconsistencies in the STARSYS application regarding STARSYS's stated intention not to offer services directly to end-users is wholly unavailing. STARSYS stated in its application, and reaffirms here, that it will not offer services; it intends only to offer satellite capacity for the benefit of its customers. The fact that Orbcomm is given pause by STARSYS's claim that it will remain responsible for system integrity and management when its anticipated twenty million end-users are on line is baffling. STARSYS's statements -- in the overview to its application and in the technical section -- as to its system's capabilities do

not conflict with its detailed operational proposals, and they certainly do not lend support to Orbcomm's charge that STARSYS's application is "nothing more than an attempt to evade the strictures of Section 310 of the Communications Act." Orbcomm Comments at 7.

In short, STARSYS is legally entitled to offer capacity on its system on a non-common carrier basis. Orbcomm's claim that STARSYS must be treated as a common carrier is completely specious, as Orbcomm should have known, and conflicts with a decade of Commission decisions. As a result, Orbcomm's claims with respect to Section 310(b) are irrelevant.[5/]

2. STARSYS's Ownership Structure Is Fully Consistent With Section 310(a) Of The Communications Act.

As part of its flawed common carrier argument, Orbcomm attempts to cast doubt upon the bona fides of STARSYS's two-tiered ownership structure. Orbcomm Comments at 8-9. It suggests that because the French parents of North American CLS, Inc., STARSYS's ninety-five percent Class B stockholder, retain a majority of votes for issues other than for the election of STARSYS directors, citizens of France (or representatives of

---

5/ Thus, there is no defined limit per se either on foreign equity ownership in STARSYS or on the number of foreign directors.

the French Government) have de jure control over STARSYS. Id. at 8. Orbcomm is plainly wrong.6/

STARSYS, Inc. is a Delaware corporation. Its articles of incorporation provide that the Class A stockholder, who owns 500 shares of STARSYS, Inc. stock (a 5% equity interest) is entitled to elect three of the five STARSYS directors. By contrast, the Class B stockholder, who owns 9,500 shares of STARSYS, Inc. stock (a 95% equity interest) is entitled to

---

6/ Orbcomm goes on to allege that, in addition to the majority stockholder's alleged de jure power, "the fact that the French parents apparently were able freely to substitute a new U.S. 'controlling' minority owner (replacing MARCOR, Inc. with ST Systems Corporation) is strong evidence that the French parents retain de facto control, notwithstanding any claims that the five percent minority owner 'controls' STARSYS." Orbcomm Comments at 8. Section 309(d) of the Communications Act of 1934 requires that allegations of fact in petitions to deny be supported by affidavits of a person or persons with personal knowledge thereof, in order to prevent the making of the sort of frivolous and wholly conjectural allegations that Orbcomm has made concerning the change in STARSYS's Class A stock ownership. See 47 U.S.C. § 309(d)(1). No such affidavit has been submitted to support Orbcomm's conjecture. Contrary to Orbcomm's allegation, Martin Rothblatt, sole owner of MARCOR, Inc., resigned his involvement and surrendered his ownership in STARSYS for purely personal reasons in which North American CLS had no involvement and over which it had no control. Moreover, ST Systems Corporation, with Dr. Ashok Kaveeshwar being President and a director of STARSYS during the period of Rothblatt's and MARCOR, Inc.'s involvement, has been intimately involved with STARSYS's creation and management from the outset. It was not, contrary to Orbcomm's suggestion, a stranger to the application at the time it decided to invest in STARSYS. In any event, neither Section 310(a) nor (b) precludes any stockholder -- foreign or domestic -- from choosing who it wishes to go into business with.

elect only two of the five STARSYS directors.[7/] Restated Certificate of Incorporation of STARSYS, Inc. at ¶ 4(i). See STARSYS Application, as amended, at Appendix 6.

The by-laws of STARSYS, Inc. (which were adopted on May 11, 1990) specify the following with regard to the number and qualifications of STARSYS directors:

> The board of directors shall consist of five (5) members. Three of the five directors shall be elected by the holders of the Class A Common Stock. Two of the five directors shall be elected by the holders of the Class B Common Stock. Three of the five directors shall be citizens of the United States. Four of the five directors shall have no business or financial relationship with (i.e., shall not be officers, directors, shareholders or employees of) North American CLS, Inc., its direct or indirect parents or any of their direct or indirect subsidiaries (other than STARSYS, Inc.) and shall not be representatives of a foreign government. So long as the corporation has an application pending before, or is operating a telecommunications facility pursuant to an operating permit or any other authorization (including any waiver or temporary special authorization) from the Federal Communications Commission ("FCC"), this Section of the by-laws may not be amended without the consent of the FCC or its delegate.

7/ In Orion Satellite Corporation, FCC 90-241, slip op. at 13 (released August 6, 1990), the Commission explicitly recognized that there are a number of potential public interest benefits to be realized from foreign capital investment (e.g., obtaining financial support and gaining commercially successful entry into key markets) in domestic satellite systems.

By-Laws of STARSYS, Inc. at Article III, Section 2. The by-laws also specify that the STARSYS board of directors has exclusive responsibility for the management of the property, affairs, and business of the corporation. Id. at Article III, Section 1.[8/]

STARSYS's Class A stockholder, ST Systems Corporation ("STX"), is a well-respected U.S. corporation specializing in high technology products and services. Founded in the 1970s, it has well over one thousand employees at locations throughout the United States. STX, as a system integrator, has developed complex turn-key systems for a wide variety of applications and customers. In particular, STX is a leader in developing Satellite Ground Processing and Analysis Centers, Oceanic Air Traffic Control, and VHF Direction Finder Systems.

Under these circumstances, where (i) STX has the absolute right to elect a majority of the STARSYS directors, (ii) this right may not be abrogated without prior Commission consent, (iii) the STARSYS directors have exclusive responsibility for the management of the property, affairs, and business of the corporation, and (iv) STX is an independent and respected company with an established reputation and proven

---

8/ Under Delaware corporate law, "the business and affairs of every corporation organized under this chapter shall be managed by or under the direction of a board of directors . . . ." Del. Code Ann. tit. 8, § 141(a).

track record, it must be concluded that STX is in full de jure and de facto control of STARSYS, Inc.[9/] Orbcomm's professed, but wholly unsupported, incredulity at the bona fides of this arrangement is insufficient to overcome the certified statements of STARSYS's principals and the reality of its organizational structure. See 47 U.S.C. § 309(d)(1).

The fact that the STARSYS ownership structure is compliant with Section 310(a) of the Communications Act is confirmed by the Commission's recent decision in Orion Satellite Corporation, FCC 90-241, slip op. (released August 6, 1990). In Orion, the Commission made clear that for purposes of Section 310(a) of the Communications Act of 1934, as amended, actual foreign ownership of equity in a Commission licensee is irrelevant, so long as U.S. citizens remain in full control of the licensee entity. Orion, slip op. at 15 n.40. Here, the STARSYS, Inc. articles of incorporation and by-laws, and the operation of Delaware corporation law, make it unequivocally clear that ST Systems Corporation is in full and complete control of STARSYS by virtue of its control of the STARSYS board of directors.[10/]

9/ All of the shareholders of ST Systems Corporation are U.S. citizens. STARSYS FCC Form 430 at Exhibit VIII.

10/ The fact that STARSYS's 95% shareholder is entitled to elect two members of the five-member STARSYS board of

(Footnote continued on next page)

In sum, STARSYS must be found to be in full compliance with Section 310 of the Communications Act of 1934. Orbcomm's unsupported and irresponsible allegations and suggestions to the contrary must be rejected as the dilatory tactic they most assuredly are. STARSYS is, in fact, legally qualified to be the Commission licensee of its proposed non-common carrier LEO MSS system.

3. STARSYS Is Technically Qualified.

At the outset, STARSYS notes that Orbcomm has again failed to provide any sworn statement attesting to the accuracy of the "factual" matters alleged. See Orbcomm Comments at 9-11. As a result, all of the technical assertions in its petition to deny are fatally deficient under Section 309(d)(1)

(Footnote continued from previous page)

10/ directors does not change this conclusion. In order to be found to be in control, an entity must have the ability to dominate the management of corporate affairs. Arnold L. Chase, 5 FCC Rcd 1642, 1648 n.5 (1990); McCaw Cellular Communications, Inc., 4 FCC Rcd 3784, 3789 (Common Carr. Bur. 1989). The Commission has made clear that "influence and control are not the same." News International, PLC, 97 F.C.C.2d 349, 356 (1984). Here, ST Systems alone has the power to determine (i.e., dominate) corporate affairs. Because North American CLS does not and cannot control the corporation, and because its two directors do not even constitute a quorum for the transaction of corporate business (majority of directors required for quorum under Del. Code Ann. tit. 8, § 141(b)), ST Systems must be found to be in control of STARSYS, Inc. notwithstanding its 5% ownership share.

of the Communications Act of 1934. Nevertheless, in the interest of creating a complete record, STARSYS proceeds to demonstrate the substantive errors in Orbcomm's analysis.

As it did in its comments in response to STARSYS's petition for rule making to establish a spread-spectrum-based LEO MSS, Orbcomm asserts that there are "flaws" in STARSYS's proposed use of spread spectrum modulation techniques at the requested frequencies. See Orbcomm Comments at 9-10 & n.17. In its Reply Comments in the rulemaking proceeding, STARSYS, with a certified technical statement, responded to each of the claims that Orbcomm reasserts in summary fashion here. See Appendix B to these Reply Comments.

Next, Orbcomm claims that STARSYS's proposed random deployment of its component spacecraft in low earth orbit will create gaps in coverage and unreliability of service. Orbcomm Comments at 10. The Technical Statement (as included in Appendix C hereto) responds in full to Orbcomm's claim, and includes explanatory materials concerning STARSYS's orbital deployment plans. Only the initial component spacecraft is to be randomly deployed in orbit; the follow-on spacecraft will in fact be deployed at precise intervals to ensure continuity of coverage and predictable reliability of service.

Finally, the Technical Statement in Appendix C hereto contains a complete response to Orbcomm's assertion regarding

polled access. Orbcomm Comments at 10-11. As it has done before, Orbcomm has presented an entirely unrealistic scenario. The STARSYS proposal is in fact pragmatic and viable. There simply is no merit to Orbcomm's assertion.

All of the matters pointed out by Orbcomm are, even if true, minor in nature. Only because Orbcomm seeks exclusive access to the frequencies has it sought to base a petition to deny, even in part, on such trivial matters. However, neither Orbcomm's dilatory tactics, nor its gratuitous assertions regarding STARSYS's ownership and its completely unsupported attack on the credentials of STARSYS's affiliates,[11/] provide any basis for the denial of STARSYS's application on technical grounds.

4. STARSYS Has Made The Requisite Financial Qualifications Showing At This Juncture; It Will Supplement Its Showing, To The Extent Required, Once The Commission Establishes A Financial Qualifications Standard For Application To The LEO MSS Service.

STARSYS stated in Section VI of its application that it could not know with any certainty what financial qualifications standard the Commission will elect to apply to

---

11/ See, e.g., Orbcomm Comments at 11 and 9 n.16. STARSYSs ownership and control are established in Section II.C.2 above. The accurate data concerning the ARGOS system is established in STARSYS's duly-certified application; it is not to be found in Orbcomm's conjectural and unsupported claims.

the LEO MSS service, although it reasonably could expect that the Commission will require applicants to show that they possess the current financial ability to meet the costs of construction and launch, and operating expenses for one year after launch, either before the construction permit is granted or at some specific point thereafter.[12/] As a result, STARSYS supplied the Commission with the estimated costs of the proposed construction and launch of its system, the estimated operating costs for one year after launch, and stated the potential sources for financing. STARSYS Application at VI-5.

STARSYS noted that such a showing would satisfy the "first-stage" showing the Commission requires of its separate international satellite system and radiodetermination satellite system applicants, and urged the Commission to find that STARSYS is qualified to receive a conditional construction permit. Id. (citing Establishment of Satellite Systems Providing International Communications, supra; Policies and Procedures for the Licensing of Space and Earth Stations in the Radiodetermination Satellite Service, 104 F.C.C.2d 650 (1986) ("RDSS Order")). Because the standard adopted in the instant proceeding may vary somewhat from the financial standards adopted for other new satellite services, STARSYS also

---

12/ Notably, STARSYS, like Orbcomm, has applied only for an LEO MSS system construction permit; launch and operating authority will not be sought until a later date.

indicated that it stands prepared to comply with whatever financial qualifications standard the Commission deems appropriate for application to the LEO MSS service. STARSYS Application at VI-5 to VI-6.

The position taken by STARSYS on the financial qualifications issue is consistent with the history of satellite authorizations. Since the first domestic satellite authorization proceeding in the early 1970s, the Commission has applied relaxed financial standards to new satellite service applicants in order to promote multiple new entry and to encourage the development of healthy competition. See Domestic Communications-Satellite Facilities, 35 F.C.C.2d 844 (1972). Now, however, the domestic fixed-satellite industry has matured to the point where the licensing of applicants without the current financial ability to finance their entire system will or may preclude other qualified domestic fixed-satellite applicants from implementing their own system plans. See RDSS Order, 104 F.C.C.2d at 663-64. As a result, applicants in this service -- and this service only -- are required to demonstrate sufficient current assets and operating revenues to cover all construction, launch, and first year operating expenses. Id. at 664 n.45.

Applicants for space station construction permits in newer satellite services (e.g., the international

fixed-satellite and radiodetermination satellite services) are evaluated pursuant to a more lenient standard. In Omninet Corp., 2 FCC Rcd 1734 (Common Carr. Bur. 1987), for example, the Bureau stated that "RDSS applicants are required to demonstrate their financial preparedness to assume the costs and liabilities of constructing and launching their systems by submitting a balance sheet reflecting assets sufficient to meet these costs, or by submitting an exhibit indicating sufficient anticipated income or revenues from system operation." Id. at 1735 n.8. Omninet was found to have demonstrated its "financial preparedness" to construct, launch, and operate its system for one year by submitting cost estimates, a business plan detailing projected revenues, and by supplying letters from three banks which "indicat[ed] their interest in arranging financing for the system." Id. at 1734.

Like the radiodetermination and international fixed-satellite services, the LEO MSS is a new service. Applicants attempting to establish a toehold in this new market should be given the same opportunities that have been provided to other satellite services entrepreneurs.[13/] Under these circumstances, it would be an error for the Commission to

---

13/ See Garrett v. FCC, 513 F.2d 1056, 1060 (D.C. Cir. 1975) (an agency cannot act arbitrarily or treat similar situations in dissimilar ways).

require that the domestic fixed-satellite financial qualifications standard be applied to the nascent LEO MSS.[14/]

In its financial qualifications argument, Orbcomm has again ignored the showing made in STARSYS's application, opting instead to fabricate its own standard. See Orbcomm Comments at 12-13. First of all, the fact that Orbcomm subjectively "finds some portions of the STARSYS cost analysis to be not credible[,]" and "believes" that STARSYS has underestimated terminal costs is irrelevant. See Orbcomm Comments at 12 & n.21. Neither assertion is supported by competent analysis or affidavit, and thus neither has any place in a petition to deny.

Also in error is Orbcomm's "presumption" that STARSYS will amend its financial qualifications in response to the Commission's July 16, 1990 public notice announcing a cut-off deadline for LEO MSS applications mutually exclusive with Orbcomm's and STARSYS's applications. The public notice does not, contrary to Orbcomm's claim, require that applicants meet the financial qualifications standards specified in "Appendix B" of the Commission's 1983 satellite application processing order. Instead, the notice limits the application of Appendix

---

14/ In this regard, Orbcomm's reliance on the Commission's domestic fixed-satellite service financial qualifications decision in Columbia Communications Corp., 103 F.C.C.2d 618 (1985) (subsequent history omitted), is misplaced. See Orbcomm Comments at 13 n.22.

B to technical matters, and specifically states that applicants will be afforded an opportunity to amend their applications to conform with any requirements and policies that may be adopted for a low-earth orbit satellite service in either the frequency allocation or licensing portions of this proceeding.15/

In sum, STARSYS provided the financial information it reasonably expects the Commission to require of new LEO MSS service applicants once a financial qualifications standard is promulgated, and remains ready to supply whatever documentation the Commission deems fit to require. Orbcomm's attack on the "sufficiency" of STARSYS's showing, insofar as there is no standard yet to measure that showing by, is premature. Orbcomm's petition to deny STARSYS's application on financial qualifications grounds must itself be denied.

III. CONCLUSION

On the basis of the foregoing discussion, STARSYS urges the Commission to heed the comments of the many parties interested in utilizing the STARSYS LEO MSS system for the provision of innovative and beneficial services, and grant the

---

15/ Id. In Aeronautical Radio, Inc., 4 FCC Rcd 6067, 6069 (1989), the Commission stated that it was error to dismiss a satellite application for a new service on the grounds that the applicant had failed to comply with a financial standard that the Commission had not formally announced in advance.

STARSYS application. In addition, STARSYS urges the Commission to deny Orbcomm's petition to deny as a dilatory and confusing filing that is wholly without merit and completely lacking in factual basis. STARSYS is, as shown here and in its application, legally, technically, and financially qualified to become a Commission LEO MSS system licensee. In no way should Orbcomm's comments be allowed to delay the processing and grant of STARSYS's application.

Respectfully submitted,

STARSYS, INC.

By: _____

Raul R. Rodriguez
Stephen D. Baruch

Leventhal, Senter & Lerman
2000 K Street, N.W.
Suite 600
Washington, D.C. 20006-1809
(202) 429-8970

September 4, 1990

Its Attorneys

Some of these benefits include:

1) **Enhanced ability to locate vessels and/or crew lost at sea.** Given the remote location of most commercial fishery operations and the often times hostile weather and sea conditions these fleets encounter, capacities such as those proposed by STARSYS could create tremendous benefits in terms of vessels recovered and lives saved;

2) **Improved messaging capability.** This factor assists the operational aspects of the fleet by increasing communication potential between shoreside managers and at-sea operators. With the advent of heightened levels of on-board government fishery observers, such a messaging capacity will also increase the timeliness and effectiveness of federal and state fisheries management efforts;

3) **Heightened enforcement capacities.** The expanse of the world's oceans surpasses the ability of conventional techniques to monitor. New techniques which use satellites to track multiple vessels over large regions of the ocean must be developed in order to effectively conserve the fisheries resources of the world's oceans.

Given these and other beneficial aspects of a new Low Earth Orbit Mobile Satellite System (LEO MSS), NRC encourages the Federal Communications Commission to allocate a spectrum in the range 127-138 MHz and 148-149 MHz to LEO MSS.

Sincerely,

Mark H. Freeberg

'90 07/19 16:00

RM 7399

DUPLICATE FILE

FCC MAIL SECTION

0001

SOUTHWEST RESEARCH INSTITUTE

8229 CULEBRA ROAD • POST OFFICE DRAWER 28510 • SAN ANTONIO, TEXAS, USA 78228-0510 • (512) 684-5111 • TELEX 244846

ELECTROMAGNETICS DIVISION

FAX (512) [illegible]

JUL 20 6 56 AM '90

RECEIVED

RECEIVED BY JUL 20 1990

Federal Communications Commission
Office of the Secretary

RM-7399

FAX COVER SHEET

Date:	7/19/90
No. of Pages (incl cover page):	3
FAX Number Called:	202-653-5402
If all pages not received, call:	512-522-2777
To (Name):	Ms. Donna Searcy
Company:	Federal Communication Commission, Rm. 222
From (Name):	M. Pike Castles
Company:	Southwest Research Institute
Telephone:	512-522-2759

Message:

SOUTHWEST RESEARCH INSTITUTE

6220 CULEBRA ROAD • POST OFFICE DRAWER 28510 • SAN ANTONIO, TEXAS, USA 78228-0510 • (512) 684-5111 • TELEX 244846

ELECTROMAGNETICS DIVISION
FAX: (512) 522-2708

19 July 1990

Federal Communication Commission
1919 "M" St NW, Room 222
Washington, DC 20554

Attention: Ms. Donna R. Searcy
Secretary

Dear Ms. Searcy:

Southwest Research Institute hereby submits this facsimile copy of comments in support of the STARSYS petition which is before the Commission. An original and five copies are being forwarded via Federal Express this evening to arrive at your office July 20th.

We appreciate the opportunity to express our support.

Very truly yours,

for M. Pike Castles
Director
Department of Surveillance
Engineering

MPC/bb

Before The
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of

Petition of STARSYS, Inc. for Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum For, and to Establish Other Rules and Policies Pertaining to, a Low Earth Orbit Mobile Satellite Service	)))))	RM-7399

TO: The Commission

Southwest Research Institute is an independent, not-for-profit, research and development organization. As such, one segment of our business is research, design, development, and consultation in the area of radiolocation and tracking. Our customer base includes both commercial and Government (local, state, federal, international).

We view the STARNET system as proposed by STARSYS as a quantum enhancement to both our business and to others. Embodied in this one system is the promise of an inexpensive 24-hour, worldwide, position determination, tracking and two-way communication capability. This is a commodity unavailable in today's marketplace at any cost.

In addition, the proposed plan uses technology (spread spectrum) to efficiently use the spectrum requested. This will aid in maximizing multiple access while minimizing conflict with co-existing services. This in itself is consistent with the public interest.

Inasmuch as the proposed system promises a potentially enormous benefit to the general public with minimal conflict to existing services, we wholeheartedly support it and, consequently, support the allocation of the requested spectrum.

Note that this statement of support is based on technological reasons and in no way legally binds the corporation of Southwest Research Institute.

Respectfully submitted,
Southwest Research Institute

By: W. Pike Castles for M. Pike Castles
Director
Department of Surveillance
Engineering

Date: 19 July 1990

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

In the Matter of

Petition of STARSYS, Inc. for Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum For, and to Establish Other Rules and Policies Pertaining to, a Low Earth Orbit Mobile Satellite Service	)

To: The Commission

COMMENTS OF MICROSAT LAUNCH SYSTEMS, INC.

MicroSat Launch Systems, Inc. ("MicroSat"), by its attorneys hereby submits its Comments on the above referenced Petition for Rule Making filed by Starsys, Inc. ("Starsys"). MicroSat is a privately-owned launch company, with its base of operations in Houston, Texas. MicroSat is developing a new commercial launch vehicle in conjunction with several major aerospace firms to provide low-cost, reliable access to low Earth orbit for dedicated payloads in the size range contemplated for the Starsys system. MicroSat has a Memorandum of Understanding ("MOU") with Starsys to provide launch services for its satellite system, and has similar MOUs with other U.S. companies interested in low earth orbit applications.

MicroSat's support of the Starsys Petition for Rule Making is based on the following points, all of which are in the public and national interest: (1) the services to be provided by Starsys are

in demand by the commercial and public sectors; (2) the use of spread-spectrum technology or other techniques to maximize efficient spectrum utilization are essential as demand for scarce spectrum continues to increase; (3) the use of spread-spectrum technology could permit competitive multiple entry among mobile satellite service providers; and (4) the allocation of frequency for low Earth orbit mobile satellite services would facilite U.S. commercial space activity. In addition, MicroSat strongly encourages the Commission to consider allocating additional spectrum to accommodate the expected increase in near-term demand for low Earth orbit satellite applications. Each of these points is discussed below.

I. The Services To Be Provided By Starsys Are In Demand By The Commercial And Public Sectors

The frequencies that are the subject of this Petition are required by the proposed Starsys satellite system, which is intended to provide a variety of communications services, including two-way data and position determination between mobile and fixed users. Starsys demonstrates in its application that its system would be used to serve critical market requirements, promote safety of life and property, and perform valuable environmental monitoring functions.[1] MicroSat believes, therefore, that the Starsys system is in the public interest and that the relevant frequencies should be allocated for this purpose.

---

[1] Application of Starsys, Inc. for a low Earth orbit satellite system, Part II-1 and Part III-1, File No. 33-DSS-P-90 (24).

II. Requiring The Use Of Spread-Spectrum Technology Or Other Techniques To Maximize Efficient Spectrum Utilization Is Essential

The Petition for Rule Making proposes the use of spread spectrum technology to ensure maximum efficient use of the radio frequencies for mobile satellite services.[2] MicroSat recognizes the limited current availability of frequencies for low Earth orbit applications, and therefore supports the proposed use of spread spectrum and other technologies that maximize the use of the resource.

III. The Use Of Spread-Spectrum Technology Would Permit Competitive Multiple Entry Among Service Providers

MicroSat strongly supports the FCC's longstanding determination that the public interest is best served by promoting competitive multiple entry satellite communications service providers to the maximum extent feasible.[3] Spread-spectrum and other technologies that permit frequency sharing among multiple systems should be used whenever possible to achieve this objective.

---

[2] Amendment to the Commission's Rules to Allocate Spectrum For, and to Establish Other Rules and Policies Pertaining to, a Radiodetermination Satellite Service, 194 FCC 2d 660-663 (1986) ("RDSS Order").

[3] See, Starsys Petition for Rulemaking at pp. 7-8; See, e.g., Domestic Communications Satellite Facilities, 22 FCC 2d 86 (1970); 35 FCC 2d 844, recon. in part, 38 FCC 2d 665 (1972). See also, Establishment of Satellite Systems Providing International Communications, 101 FCC 2d 1046 (1985); RDSS Order, supra, 104 FCC 2d 650 (1986).

IV. The Allocation Of Frequency For Low Earth Orbit Mobile Satellite Services Would Facilite U.S. Commercial Space Activity, Which Is In The National Interest

Now more than ever before, U.S. national space policy is to seek and encourage maximum private sector involvement in space-related activity.[4] As demonstrated below, private sector interest in such activity is increasing, particularly in low Earth orbit applications. Allocation of frequencies for such applications will be critical in this regard.

The Starsys application for a low Earth orbit constellation of 24 low-cost, small satellites is among the first examples of a growing demand for such systems. Orbital Sciences Corporation and Motorola have also filed applications with the Commission for low Earth orbit constellations of 20 and 77 small satellites, respectively. Recent market studies indicate that demand for such systems will increase rapidly in the next several years.[5] So too, will the demand for spectrum increase to support these systems.

---

4. U.S. National Space Policy (November 16, 1989).

5 A 1988 study by the European launch company Arianespace predicted 20 small spacecraft would be launched annually to low Earth orbits by 1993, and 35 per year by 1996; this forecast has already been exceeded by the 1990 launch rate. Small Payloads ELV Systems Study, Report No. SAIC-89/1638, Study No. SAIC 1-120-684-S27, Science Applications International Corporation, Schaumburg, IL, for NASA Lewis Contract NAS3-25351, November 1989, pp. 30, 32 & 69.

A more recent study by Science Applications International Corporation (SAIC) for the Advanced Space Analysis Office at NASA Lewis indicates demand for approximately 35 launches per year between now and the year 2000, with occasional surges to sixty per year during this period. "Auxiliary Payloads on Ariane," P. Larcher, Arianespace, Evry, France, Proceedings of the First European Workshop on Flight Opportunities for Small Payloads, ESA SP-298, April, 1989, p. 175

Increased demand for low-cost, small satellite constellations in low Earth orbit will stimulate demand for smaller, less expensive launch vehicles. MicroSat, among others, is developing vehicles to meet that demand. This, in turn, should stimulate competition among launch service providers, and drive launch prices down as a result.

As the cost of both satellites and launch vehicles decline to more affordable levels, the ability to become involved in commercial space activity will extend to a larger cross-section of government and industry worldwide. Even entities not traditionally involved in space-related activities will be able to afford launches to explore business opportunities. This is the point at which the "real" technological breakthroughs should begin to occur, with entities competing to find new ways to access and utilize space at the lowest possible cost.

V. The Commission Should Consider Allocating Additional Spectrum For Low Earth Orbit Satellite Applications

In addition to supporting the allocation of frequencies requested by Starsys, MicroSat strongly urges the FCC to consider the need for allocating sufficient additional frequency spectrum to accommodate the expected increase in demand for low Earth orbit communications satellite systems in the next several years.

The critical need for the Commission to act expeditiously in this regard is perhaps best emphasized from an international trade and competitiveness perspective. Specifically, the establishment of low-cost low Earth orbit satellite systems opens new global market opportunities for U.S. spacecraft and launch vehicle

manufacturers, and service providers, if they can seize the initiative. It also provides the U.S. the opportunity to set the standards in this arena for the rest of the world. However, if the U.S. does not sieze the initiative, our foreign competitors will be positioned to do so. Since low Earth orbit systems by their nature have global capability, the first systems established will have clear competitive advantages with respect to international markets.

At minimum, MicroSat believes the FCC should support the proposal on the Agenda for the ITU 1992 World Administrative Radio Conference to provide an allocation of 5 MHz of a frequency band below 1 GHz to low Earth orbit satellites on the basis of appropriate sharing critieria.[6]

Conclusion

The establishment of small, low-cost communications satellites for operation in low Earth orbit, such as the systems proposed by Starsys and others, have extreme significance in the timeline of the developing commercial space industry. In many respects, their use of miniaturization technologies to reduce costs and penetrate new markets is analogous to the advances in the computer industry, where the initial room-sized government computers have now been replaced by powerful desk-top versions at prices that households can afford. In order to facilitate this trend, and to ensure that the U.S. sets the standards in this new industry rather than

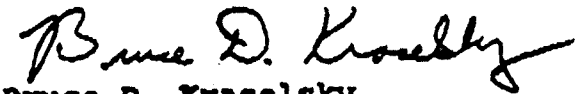
---

[6] Agenda Item 2.2.4 for WARC 1992, contained in Circular Telegram No. A87 to the Members of the International Telecommunication Union (21 June 1990).

follows the pack, the Commission should expeditiously allocate the necessary frequencies, and expedite licensing of qualified U.S. applicants for such new satellite systems.

Respectfully submitted,

MicroSat Launch Systems, Inc.



By: Bruce D. Kraselsky
Of Counsel

Davis Wright Tremaine
1752 N. Street, N.W.
Suite 800
Washington, D.C. 20036
(202) 828-2388

MEMBER COUNTRIES – PAISES MIEMBROS
COSTA RICA
FRANCE
JAPAN
NICARAGUA
PANAMA
UNITED STATES OF AMERICA

INTER–AMERICAN TROPICAL TUNA COMMISSION
COMISION INTERAMERICANA DEL ATUN TROPICAL

Established in 1950 by treaty between the United States of America and the Republic of Costa Rica for the investigation and conservation of the tuna resources of the eastern Pacific Ocean.

Establecida en 1950 por medio de un tratado entre los Estados Unidos de América y la República de Costa Rica para la investigación y conservación de los recursos del atún en el Océano Pacífico oriental.

Director
Jerome Joseph

c/o Scripps Institution of Oceanography
La Jolla, California
U.S.A. 92093

Telephone: 619 546–7100
Cable Address: TUNACOM
TELEX: 697 115
FAX: 619 546–7133

DUPL. FILE

RECEIVED BY

FCC MAIL BRANCH

18 July 1990

In the Matter of RM-7399

Petition of STARSYS, Inc. for Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum For, and to Establish Other Rules and Policies Pertaining to, a Low Earth Orbit Mobile Satellite Service

RECEIVED

JUL 20 1990

Federal Communications Commission
Office of the Secretary

To: The Commission

COMMENTS OF THE INTER-AMERICAN TROPICAL TUNA COMMISSION

The Inter-American Tropical Tuna Commission is an agency for the management of the international fishery for tunas in the eastern Pacific Ocean. The staff conducts research on the biology of the tunas, dolphins, and other species that are affected by the fishery. The member countries of the Commission now are Costa Rica, France, Japan, Nicaragua, Panama, and the United States. We find the STARSYS proposal of interest in two ways, 1) the ability to monitor the movements of animals, particularly the dolphins, and 2) the ability to monitor the position and receive data from our scientific technicians at sea.

The proposed system by STARSYS would be an improvement for wildlife tracking over the current ARGOS system, particularly for marine mammals and particularly for animals in the tropics. Currently, a diving dolphin would need to surface several times during the few minutes that the satellite is overhead, otherwise no position, or an unreliable one, will be obtained. This problem is particularly acute in the tropics where the number of satellite passes per day are low. The proposed STARSYS system will likely alleviate these problems because the large number of satellites will allow continuous monitoring and accurate positions to be calculated for just a single transmission.

The system would also aid in the rapid and secure transmission of data from our staff aboard tuna vessels at sea. This would increase our ability manage the fishery on a real-

time basis. Such data would provide us with timely information on tuna catches, dolphin mortality, and environmental conditions. All of these are of critical interest to the fishery and conservation groups, and obtaining these data would serve the public interests of the United States and other countries.

We would like to express support for initiation of a rulemaking to consider allocation of the proposed frequency bands for the STARSYS system.

Sincerely,

Dr. Martin Hall
Head, Dolphin-Tuna Program
Inter-American Tropical Tuna Commission

APPENDIX B

STARSYS

TECHNICAL STATEMENT

Orbital Communications Corporation asserts that the spread spectrum modulation requirement that STARSYS has incorporated into its petition for rule making to establish low earth or mobile satellite system is unworkable, inefficient, and impractical. From its discussion it is clear that Orbcomm does not understand the technical aspects of the STARSYS proposal and that it is unaware of current applications of spread spectrum techniques that show them to be practical, effective against interference, and efficient in their use of the spectrum.

Oversights in the Orbcomm Analysis of Uplink Signal Jamming:

The examples quoted by Orbcomm used the extremely conservative numbers generated by STARSYS for a committee document,[1] and were never intended to represent a "real world" situation. We present here additional analysis of the system, based on established theory of spread spectrum communications, and an investigation of the existing and anticipated users in the proposed uplink band. Our conclusion is that the spread spectrum techniques proposed by STARSYS will work. As explained below, the potential for jamming by land mobile users is solvable. Thus the Orbcomm statement that the system is unworkable is not correct.

Orbcomm states that the jamming margin of the proposed Starsys system is only 17 dB. The formula for the jamming margin is given by Viterbi[2] as:

$$\text{Jamming Margin} = (\text{Jammer Power})/(\text{Signal Power}) = (W/R_b)\,(E_b/N_0)$$

where W is the total bandwidth

R_b is the information bit rate before coding.

E_b is the energy in one information bit;

N_0 is the thermal noise power density.

---

[1] "Technical Characteristics of a Low-Earth Orbiting (LEO) Mobile Satellite System" Marvin Senter and Ken Newcomer, CCIR Study Group IWP 8/14 Document Numbers 308 & 309, July 16, 1990

[2]"Spread Spectrum Communications-Myths and Realities" A.J.Viterbi, I.E.E.E. Communications Magazine, May 1979.

The proposed information rate is 4167 bits per second on the return link from the user terminals. Regardless of the detailed methods for direct sequence pseudo noise chipping, and regardless of the RF modulation method, the processing gain depends on the total exploited RF bandwidth and the information bit rate. Since the proposed band is 1 MHz wide, with the above bit rate we calculate:

$$W/R_b = (1.0 \times 10^6 / 4.167 \times 10^3) = 240, \text{ or } 23.8 \text{ dB}$$

The required E_b/N_0 depends on whether or not error correcting coding is used. Viterbi[3] gives the following table of the required E_b/N_0 as a function of the error correcting code rate for a convolutional code with a probability of bit error of 10^{-5}

TABLE 1

Code Ratio (Info.bits/Trans. bits)	Required E_b/N_0 (dB)
1.0 (uncoded)	9.6
7/8	6.4
3/4	5.5
1/2	4.5
1/3	4.0
lim (1/n) $n \to \infty$	3.4

State of the art coding methods, using judicious combinations of block and convolutional codes, can reduce these numbers still further. For rate 1/3 composite codes we expect to achieve a value of 2.3 dB. Thus we have a jamming margin as follows:

$$J_M = (W/R_b)\text{dB} - (E_b/N_0)\text{dB} = 21.5 \text{ dB}$$

The conservative jamming margin of 21.5 dB resulting from the basic system processing gain enables communication in the presence of interferers. It will be shown later that further enhancement is achieved by the use of Fast Fourier transform processing techniques.

---

[3]"When Not to Spread a Spectrum a Sequel" A.J.Viterbi,IEEE Communications Magazine, Vol 23, No.4 pp12-17, April 1985

In Appendix 1, Orbcomm states that "... STARSYS user terminals and the interfering terminals have similar antenna patterns ...". This is much too pessimistic. Land mobile systems normally use an antenna that has a null to the vertical and is omnidirectional in a circular pattern along the earth's surface. The Starsys antenna pattern would favor the vertical elevation angle. The ideal is a hemispheric pattern for the ground terminals for a low orbit satellite system. For most of the satellite path, the difference in antenna gain should yield an EIRP advantage of 10 dB or more. In the system analysis below, we consider several different possible satellite system antenna advantages from 0 to 10 dB. Furthermore, although the base station of a fixed/mobile licensee may have 50 watts of power, most of the emissions are from mobile terminals that have at most 5 to 10 watts.

In Appendix 1, Orbcomm applies Poisson statistics to the problem of finding a number of carriers within a band of frequencies. The problem is not that of finding a carrier along the frequency band. Rather it is the problem of having one or more carriers on during the time interval when the Starsys message signal is being transmitted. Furthermore, the formula used by Orbcomm is for the placing of points on a continuous line. The real problem is the activity of an interfering signal out of a finite set of possible interferers. The numbers in frequency are not large enough to use the limiting Poisson formula given. In the example below, the proper statistics are applied.

Analysis of STARSYS' Proposal:

The ability to operate reliably in the presence of current users is the main reason that prompted STARSYS to propose a spread spectrum system using code division multiple access (CDMA) with pseudo noise (PN) codes. As a first analysis we consider the signals from the land mobile users that share the uplink band as if it were spread across the band. Later we shall show that there are techniques that can be used further to reduce the interference from high-power narrow-band signals.

The incidence of jamming will be observed principally on the uplink from the small user terminals to the satellite. If the system can support reliable communications from these low power transmitters, the other elements can easily be made to function reliably.

Table 2 gives the uplink power/noise budget from these mobile terminals. The numbers for the terminals were selected to keep the cost low and to keep the battery weight down. The antenna was initially conceived as a simple whip. The effective isotropic radiated power can be increased with a small increase in cost. A simple antenna with a transmitter output power level of 2 Watts can be used on a hand held terminal without any pointing requirements other than holding the unit with the correct side pointing upward.

TABLE 2

"STARSYS LINK PARAMETERS"

	Forward		Return	
	Up	Down	Up	Down
Net P_T (W) / channel	0.1	2.0W	2.0	1.0
G_T (dBi)	16	2.0	1.0	3.0
EIRP (dBW)	6.0	5.0	3	+3.0
L_s (dB)	147.37	146.76	147.37	146.76
Pol Loss (dB)	2	2	2	2
Rec. Loss (dB)	0.5	2	0.5	2
G_R (dBi)	3.0	1.0	3.0	16
Carrier level (dBW)	-140.87	-144.76	-143.87	-131.76
T_S (dBK)	425	500	425	300
G_R/T_S dB/K	-23.3	-26	-23.3	-8.8
C/N_o (dBH_3)	61.45	56.85	58.45	72.07
R_b (b/s)	8334	8334	4167	4167
E_b/N_o available	22.24	17.64	22.25	35.87

Overall System Parameters

Bandwidth	B	1.0 MHz	Orbital Alt	1300 km
Coded Symbols	R_s	25000 b/s	Range at 5°	3752 km
Chips	R_c	1000 k chip/s	Orbital Per	111.6^m
Code Rate	r	1/3 (Convolutional Code)	Orbital Pass	21^m
Error Probability	P_e	10^{-5}		
Required E_b/N_o	$(E_b/N_o)_{req}$	2.3 dB		

STARSYS proposes using one megahertz out of the band of frequencies from 148 to 149.97 megahertz for the uplink. This band is currently assigned to land mobile service. Data provided by the FCC show that there are 74 commercial users on 30 different channels in the band and 3827 government users on 143 channels. Of the 3900 total users, it is reasonable to assume that about 50% are in service at any one time. Furthermore, STARSYS' system will only be using 53% of the band. Assuming a uniform distribution of users over the band and a voice activity factor of 33%, we could expect to have approximately 321 users operating in the uplink band at any one time.

A land mobile licensee, such as a fire department or a commercial delivery service, normally has one base station and a number of mobile terminals. Only the base station has up to 50 watts of power. The mobile terminals usually operate with 5 to 10 watts. Since the base and mobile stations transmit alternately, a practical assumption is that the average power of all transmitters is 30 watts.

If we consider the worst case of a satellite positioned at the center of the CONUS area, the angle of elevation of each interfering terminal will be greater than or equal to 25°. For these high elevation angles, it is reasonable to assume that the antenna gain of the base stations and the mobile terminals in the direction of the satellite is on the order of -10 dB. The Appendix contains a detailed analysis of the geometry of multiple transmitters scattered over the spherical cap visible from the satellite. The

results are in the form of equivalent interfering powers as a function of the mean traffic intensity in Erlangs.

A Means of Reducing Interference from High Power, Narrow Band Jammers

The above calculations assume that all the interfering signals are spread across the spectrum as noise. The base station signals will look like high power narrow band jammers. There are well-known techniques[4] for combating the effects of such jammers. The technique is to locate the jammer in frequency and then attenuate the jammer with a notched filter. With digital signal processing, it is easy to locate the narrow band high power jammers in the frequency spectrum. One computes the fast Fourier transform (FFT). The signals in question are confined to a band of one megahertz. By translating the signal down to the band from dc to one megahertz, the signal is well within the frequency range for which digital signal processing chips can compute the FFT as fast as the signals are received in a pipeline processor. Clipping the few sharp peaks that will appear when high power, narrow band signals are present is the same as using notched filters. The signal can then be converted back to the time domain by an inverse FFT. The computation could be done by a common signal processor chip set used for cross correlating, Doppler tracking , and Fourier transforms. As the notched filters produce a small distortion of the desired signal, they would probably be used only against the more severe interferers. If there are no more than the equivalent of ten such filters, then there should be no problem with signal detection after the inverse FFT.

For a particular interval of time, we must find the probability that some number of base stations will transmit during that interval. The data intervals of STARSYS' system are short compared to the mean holding time of the average land mobile user. Thus it is appropriate to consider the probability of transmissions (n) being initiated in any mean holding time interval. If, during that interval, n transmissions are initiated, then at some instant of time, all n will be transmitting. The appropriate formula for the probability of k arrivals in a time interval t given n potential users is

[4]"Adaptive Narrow-Band Interference Rejection in a DS Spread Spectrum Intercept Receiver Using Transform Domain Signal Processing Techniques" J.Gevargiz et al, IEEE Transactions on Communications, Vol.37, No.12, December 1989

$$P(n,k) = \binom{n}{k} p^k \, q^{(n-k)}$$

where n is the total number of active licensees;

k is the number transmitting in the designated interval;

p is the probability that a station is active in the interval t;

q is the probability that a station is inactive; q = (1-p);

$\binom{n}{k}$ is the binomial coefficient $\dfrac{n!}{k!\,(n-k)!}$

Since the proposed narrow band jammer rejection system will reject only those base stations that present the maximum signal to the satellite, we compute the number of stations that will be active in a holding time interval for several cases. If 200 stations have power above the clipping threshold, the probability that more than 10 stations will be clipped is 5%. If 150 stations have sufficient power to exceed the clipping threshold, the probability that more than 10 stations are clipped is only about 0.1%.

When the FFT and clipping technique is applied, distortion will result if too many signals are clipped. The distortion of the individual equivalent notched filters will add up. Thus we must set the clipping threshold to eliminate the higher powered base stations and not clip the mobile stations. This can be done without hampering the feasibility or efficiency of STARSYS' system.

Multiple Access

Orbcomm has raised the question about the efficiency of spread spectrum, or code division multiple access. In a classical paper by Viterbi[5] he shows that indeed FDMA and TDMA provide more simultaneous accesses and system throughput. Since it was not relevant to that particular paper, Viterbi did not effect of brief messages and the ability to connect many users and "overbook" the system by a large factor and achieve demand-assigned operation. To accomplish the same purpose with FDMA requires dynamic frequency assignment and is likely to produce other system complications. We first calculate the number of simultaneous messages possible with CDMA, assuming that the users of the system all appear as active white Gaussian noise (AWGN) to each other. This is easily shown to be equal to:

$$M = 1 + g[1-(C/N_o'/C/N_o)]/(E_b/N_o')$$

Using the previously calculated numbers this yields:

$$M = 135$$

More refined calculation[6], taking advantage of the cross correlation characteristics of maximal length codes, show up to 200 simultaneous accesses. In any case no such number is necessary to handle the projected traffic. For a 90 ms message once an orbital pass, the traffic intensity is about 320*10-6 Erlangs, assuming that the terminals offer their traffic during the busiest 25% of the 20 minute orbital pass. The total traffic for 10,000 terminals is thus about 3.3 Erlangs. Consulting tables[5] of required number of trunks vs. traffic intensity for Poisson distributed traffic with a probability of blocking less than 0.001, the system capacity is more than sufficient and, indeed, has substantial growth possibilities.

---

[5] loc.cit

[6] "Reference Data for Engineers: Radio, Electronics, Computer, and Communications: Seventh Ed., Howard W. Sams & Co., Indianapolis, Indiana 1986

Orbcomm FDMA Inbound Uplink

$B = 1.5\ R_B = 7200$ Hz ($R_B = 4800$ b/sec)

Doppler = 6300 Hz

Stability = 3000 Hz (2×10^{-5})

SUM = 16500 Hz

That is 60 channels for a 1 MHz Band.

If we consider that we do not need any synchronization bits, that number represents 288,000 bits/sec which is less than the 375,000 bits/sec that Orbcomm claims for its bit rate.

STARSYS CDMA Inbound Uplink

If we have the formula given in Appendix 2 of the Orbcomm document, with the value given in Table 2.

$$10^{\frac{-\left(\frac{E_b}{N_0}\right)_{Req}}{10}} = 10^{\frac{-\left(\frac{E_b}{N_0}\right)_{Av}}{10}} + 10^{\frac{-\left(\frac{C}{I_0}\right)_{Single}}{10}} xN_i xR_b$$

in which

$$\left(\frac{E_b}{N_0}\right)_{Req} = 2.3dB$$

$$\left(\frac{E_b}{N_0}\right)_{Av} = 22.4\ dBs$$

$$\left(\frac{C}{I_0}\right)_{Single} = 60.0\ dB$$

$$R_b = 4167\ bits/\text{sec}$$

Thus we can compute

$$N_i\ R_b = 583{,}000\ bits/second$$

Thus the Orbcomm equation, using the Starsys parameters in Table 2, yields a capacity of 583,000 b/s which is twice the capacity of Orbcomm's FDMA inbound link. We consider both these analysis to be unsophisticated and only indicative in a broad way of the system capacities. In the Appendix we have

carefully calculated the composite carrier to noise densities considering thermal noise, intrasystem interference, and external interference on the composite forward and return links. The results are given for several different mean traffic intensities and show adequate system margin for average individual interferer traffic up to 0.2 Erlangs. The mean interfering transmitter levels at the satellite were determined by integration over the visible spherical cap of the homogeneously distributed transmitters, allowing for variations in slant range and elevation angle. The fundamental inputs are based on FCC issued licenses and frequency assignments in the band and are conservative inasmuch as many of the licenses are likely to be inactive, or at least quiescent. Note from Tables A2 and A3 that this is a complex calculation and there are sixteen separate terms that contribute to the final answers.

Terminal Costs

Orbcomm claims that the use of spread spectrum system technology will drive up the user terminal costs significantly. There is no real basis for such a statement. The greatest part of the cost of small satellite terminals is always in the mechanical content, i.e. the antennas, RF head, and packaging . The electronic circuitry is executed with chip technology and the costs are largely in engineering and independent of the circuit design. In the quantities under discussion here, there is no reason why CDMA should cost any more than FDMA. STARSYS engineers will develop application-specific integrated circuits (ASICs) to perform the more complex functions required for the mobile satellite terminals. The frequency range and spreading rate proposed are appropriate for ASIC signal processors. Low cost is enhanced by the use commonly available VHF components in one to two Watt terminals.

APPENDIX

1. TOTAL NOISE INDUCED BY THE GOVERNMENTAL SYSTEMS ON A SPREAD SPECTRUM LEO MSS

There are 3900 officially-declared emitters in the CONUS area in 1 MHz band between 148 MHz and 149.9 MHz.

Of the 3900 total users, it is reasonable to assume that about 50% are in service at any one time. Furthermore, STARSYS' system will only be using 53% of the band. Assuming a uniform distribution of users over the band and a voice activity factor of 33%, we could expect to have about 321 users operating in the band requested for the STARSYS system uplink. These emitters are supposed to have a uniform distribution in the CONUS area.

The service is mainly a fixed-mobile service, including base station with a 50 watts power and mobile terminals with a 5 to 10 watts power.

We will suppose that each of the 321 stations has an emitting power of 30 watts. The total power received by the satellite positioned on the center of the CONUS area is given by:

$$P_{TOT} = P_i\, N_i\, A \int_0^{\beta_{max}} \frac{10^{-\left[\frac{39}{\pi} atan\left(\frac{1}{\tan\beta} - \frac{1}{2\sin\beta}\right) - 6.5\right]}}{r^2 + 1 - 2r\cos\beta} \sin\beta\, d\beta \qquad (1)$$

where:

P	=	30 watts
A	=	Spatial loss at 130 km + polarization loss + multipath loss A = 139 - 3 - 3 = 145 dB
r	=	$h_s/R_T + 1$ with h_s + 1300 km; R_T = 6378 km
β	=	as indicated by the figure β_{max} = β value for the edge of the CONUS area ~ 25°

APPENDIX A

COLLEGE OF
OCEANOGRAPHY

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of

Petition of STARSYS, Inc for Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum For and to Establish Other Rules and Policies Pertaining to, a Low Earth Orbit Mobile Satellite Service

RM-7399

To: The Commission

Comments of Dr. R. Dale Pillsbury

Oceanography Adm Bldg 104
Corvallis, Oregon
97331-5503

I am a member of the faculty of the College of Oceanography at Oregon State University. I have a long-time interest in the collection of data from moored instrumentation used in oceanography. Our activities are world-wide and long term in interest.

Telemetry from buoys is presently very limited and any addition to that capability will be of benefit to the oceanographic community. STARSYS appears to request a change in allocation of spectrum which would increase our capability to return data from remote locations. The petition appears to ensure that there will be competition in the use of the frequency allocation.

The STARNET system appears to meet many of the needs of the oceanographic community. The communication will be two-way. The cost will be low. The service will be available world wide.

Telephone
503-737-3504
Fax
503-737-2064

The present "ARGOS" system fills a very real need in the oceanographic community. The additional capability of STARNET will lower the cost of the service and increase the capability.

R. Dale Pillsbury
July 18, 1990

Washington, D.C. 20554

In the Matter of

Petition of STARSYS, Inc. for Amendment of Section 2.1016 of the Commission's Rules to Allocate Spectrum For, and to Establish Other Rules and Policies Pertaining to, a Low Earth Orbit Mobile Satellite Service	)	RM-7399

To: The Commission

Comments of the Polar Science Center, Applied Physics Laboratory, College of Ocean and Fishery Sciences, University of Washington

Since 1979 the Polar Science Center has maintained a network of drifting ARGOS buoys with the objective to monitor the fields of surface atmospheric pressure, temperature and ice motion in the Arctic Ocean. Data from the program are used for basic research, applied research, environmental monitoring, and operational forecasting by an international community. A reliable, polar orbiting satellite system is required for platform positioning and data transmission.

The Polar Science Center has been a longtime user of the ARGOS system. It is my understanding that STARSYS is the next generation of satellite based positioning and data transmission system. The polar orbiting system is required because geostationary systems do not view the Arctic Basin. Our monitoring network also requires simple, reliable, low power electronics to operate unattended on the drifting ice pack. The projected low cost of the electronics and data processing are also very attractive.

A next generation system, such as that proposed by STARSYS appears to meet our ongoing requirements for positioning and data transmission.

Respectfully submitted,

Roger Colony
Research Scientist

Date: 12 July 1990

cc: R. Spindel

TOTAL P. 2

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

In the Matter of	)	
	)	
Petition of STARSYS, Inc. for Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum For, and to Establish Other Rules and Policies Pertaining to, a Low Earth Orbit Mobile Satellite Service	)	RM-7399

To: The Commission

Comments of: THE VOLUNTEER OBSERVING SHIP PROGRAM
SCRIPPS INSTITUTION OF OCEANOGRAPHY
UNIVERSITY OF CALIFORNIA, SAN DIEGO

For more than a decade, the Volunteer Observing Ship Program at Scripps has worked to obtain data essential to oceanographic, weather, and climatological studies, by placing automatic and semi-automatic instruments on board commercial cargo and fishing vessels. This program, involving cooperation among Government, Academic, and private business entities now provides approximately half of all bathymetric temperature data for the Pacific Basin.

Success of this extremely important environmental monitoring program depends upon the volunteer efforts of both the operating companies and the ship officers. In recent years, the installation of automatic satellite data transmitters (utilizing the GOES system) on many of our ships has greatly increased the morale and cooperation of these volunteers by decreasing the labor involved in real-time reporting of both ocean temperature and weather observation data. Unfortunately, the limited availability of satellite channels, and the high cost of transmitters have made it impractical to provide such improved equipment to all of our volunteer ships.

The proposed LEO-MSS system suggested by STARSYS would provide an alternate very low-cost facility for the real-time reporting of oceanographic and meteorological data. In addition it would provide a method for automatically computing and recording the position of the observing ship, thus relieving volunteer operators of another chore, and increasing the accuracy of data reporting.

We estimate that, if it becomes available, our program could use about 50,000 to 100,000 message units per year (as described in the STARSYS proposal) just to gather the kinds of data our ships currently report. The addition of two-way service (not now available), coupled with low costs would likely lead to the development of additional modes of ocean observation, and so even more use of the system could be anticipated by our own and other ocean environment monitoring programs.

We would like to urge the Commission to consider the rulemaking proceeding suggested by STARSYS. We firmly believe that the development of a service as described in the STARSYS proposal is very much in the public interest.

Respectfully submitted,
Volunteer Observing Ship Program

By: Norman F. Hall

Norman F. Hall
Programmer/Analyst
SIO/VOS (A-030)
Scripps Institution of Oceanography
University of California, San Diego

RM-7399

NRC

Natural Resources Consultants, Inc.

4055 21st AVENUE WEST
SEATTLE, WASHINGTON 98199, U.S.A.
TELEPHONE: (206) 285-3480
TELEFAX: (206) 283-8263

TELEFAX

DATE: July 19, 1990 FAX: 202/653-5402

TO: Ms. Donna R. Searcy, Secretary, FCC

FROM: Mr. Mark H. Freeberg, Natural Resources Consultants, Inc.

SUBJECT: Letter of Support, STARSYS Inc. petition regarding LEO MSS

MESSAGE:

NUMBER OF PAGES, INCLUDING THIS COVER SHEET: 3 pages x 5 copies = 15

If there are problems in transmission, call NRC at (206) 285-3480. Our telefax number is (206) 283-8263

NRC
NATURAL RESOURCES CONSULTANTS, INC.

4055 21ST AVENUE WEST
SEATTLE, WASHINGTON 98199, U.S.A.
TELEPHONE: (206) 285-3480
TELEFAX: (206) 283-8263

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

In the Matter of

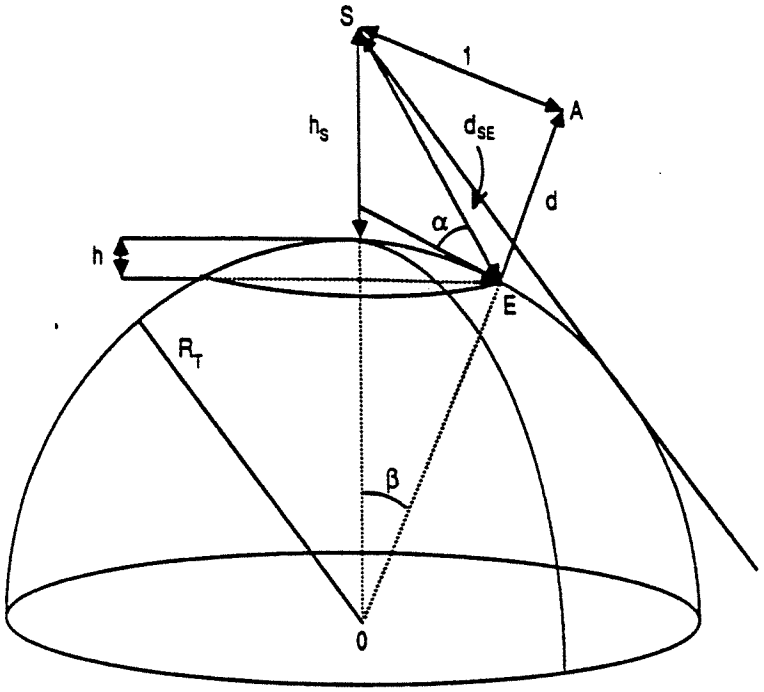
Petition of STARSYS, INC. for Ammendment of Section 2.106 of the Commission's Rules to Allocate Spectrum for, and to Establish Other Rules and Policies Pertaining to, a Low Earth Orbit Mobile Satellite Service

RM-7399

To: The Commission

COMMENTS OF NATURAL RESOURCES CONSULTANTS, INC

Natural Resources Consultants, Inc (NRC) is a comprehensive consulting firm specializing in the assessment, conservation, use, and commercial development of marine and inland fisheries. NRC is particularly involvemed with the commercial and recreational fisheries of the Pacific Northwest and Alaska, and is very familiar with the characteristics of fisheries in other regions of the nation and world. This knowledge suggests to NRC that the spread spectrum modulation allocation requested by STARSYS will provide tremendous benefits to existing commercial and recreational fisheries.



Determination of *Ni*:

If we assume a traffic of μ Erlang per station, the probability for i stations to emit simultaneously is given by a binomial law:

$$p(i) = \binom{N_e}{i} \mu^i (1-\mu)^{N_e - i} \tag{2}$$

with N_e = the total number of emitting stations (321). With N_e large and μ small (l) tends to be a Poisson's law (telephone traffic).

In our case, the law is a normal law with a mean value m ($m = N_e \mu$) and a variance of $\sigma^2 = N_e \mu (1-\mu)$. To obtain the simultaneous emitter number *Ni* with a probability of 1% in a normal law:

$$\begin{aligned} Ni &= m + 2.3\sigma \\ Ni &= Ne\ \mu + 2.3\sqrt{Ne\ \mu(1-\mu)} \end{aligned} \tag{3}$$

If we integrate the formula (l):

Thus the total power induced by a fixed-mobile service in a 1 MHz band at 148 MHz can be computed for various traffic assumptions. These values are shown in Table 1.

TABLE A1. Total Power Induced by the Ground System in a 1 MHz Band at 148 MHz

Voice Factor = 0.3 N_c = 321

Traffic Erlang	*Ni* at 1% (2.3 σ)	P_{TOT} (dBw)	dBw/Hz	Forward CND	Return CND
0.1	44	15.4	-189.6	48.73	45.73
0.2	80	18.0	-187	46.13	43.13
0.3	115	19.6	-185.4	44.53	41.53
0.4	148	20.7	-184.3	43.43	40.43
0.5	181	21.6	-183.4	42.53	39.53
0.6	212	22.2	-182.8	41.93	38.93
0.7	243	22.8	-182.2	41.33	38.38
0.8	273	23.3	-181.7	41.83	38.33
0.9	301	23.8	-181.2	40.33	37.33

2. PERFORMANCE ANALYSIS

We have analyzed the performance of the system on both the forward and return links in the presence of thermal noise, interference from other users, and interference from terrestrial mobile transmitters. The forward and return channels use the same transponder and frequencies and constitute the intrasystem interference for the desired carriers to be received at the central station and at the user terminals. Accordingly, RF budgets are calculated considering all the possible interferences and the model used will serve ultimately to optimize the system design.

Table A2 shows the forward and return, up and down, link budgets using conservative values to achieve the adequate system margins. We expect to continue the refinement of parameters so as to improve the performance still further.

It is of interest to follow through one complete computation of composite carrier to noise density (CND), including the effects of all interferers. Having computed the carrier level for each of the four links (forward uplink, forward downlink, return uplink, and return downlink), we can treat the interference on each link as the sum of all of the undesired carriers in the receiver. We compute (C/N) resulting from each source of interference and add the various equivalent noise powers. The carrier to noise

densities combine using the familiar "resistors in parallel" formula. Note that the noise levels are computed per Hz of bandwidth. For a 1.0 MHz bandwidth this in effect adds 60 dB to the carrier to noise densities and provides the "spreading" gain.

For example, let us compute the total carrier to noise density (CND) for the forward uplink channel. We already have calculated the C/No resulting from considering thermal noise to be 61.45 dBHz. The desired signal in this case has a carrier level of -140.87 dBW. The noise due to interference from the return uplink is 12*(-143.87 dB). Spread over a 1 MHz bandwidth, this noise is 10*log(12)-143.87-60 = -193.08 which results in a $(CND)_1$ of -140.87-(-193.08) = 52.51 dBHz. On this same link, there is also interference from the other three uplink channels which have different spreading codes. The "undesired" carriers contribute 3*(-140.87)-60 = -196.1 dB of noise, giving us a $(CND)_2$ of (-140.87-(-196.1) = 55.23 dBHz.

The CND of the interfering land mobile system contributes noise as a function of traffic intensity. For the case of 0.1 Erlang in the forward link, $(CND)_3$ = 48.73 dBHz.

Now we can compute the composite C/N for the forward uplink as:

$$1/(CND) = 1/(CND)_0 + 1/(CND)_1 + 1/(CND)_2 + 1/(CND)_3$$

From which we compute

$$(CND) = 46.36 \text{ dBHz}$$

Having computed a composite CND for both the uplink and downlink, an overall "up & down" composite can be computed by the same technique. The result is

$$(CND) = 44.47 \text{ dB}$$

This number is to be compared to the required value which is easily arrived at from the bit rate and the threshold value for Eb/No. Using values discussed previously

$$(CND)_{reqd} = Eb/No + Rb$$

which gives us two values corresponding to the two data rates:

$$(CND)_{forward} = 2.3 + 10 \log 8334 = 41.51 \text{ dB}$$

$$(CND)_{return} = 2.3 + 10 \log 4167 = 38.50 \text{ dB}$$

Thus the CND margin is

$$\text{Margin} = 44.47 - 41.51 = 2.96$$

Complete tables are given for realistic interference traffic values of 0.1 and 0.2 Erlang in Tables A2 and A3. Note that we have full performance with this much traffic and that there still are the 2.0 dB of margin in the receiver. The calculations are also for a weighted average interfering transmitter power of 30.0 Watts, perhaps on the high side.

TABLE A2. Starsys Link Analysis for 0.1 Erlang

Simult.Users	12
Forward channels	4
RF Band.(KHz)	1000
10 log (RF Band)	60 dB
Inter.Traffic (E)	0.1

	Forward		Return	
	Up	Down	Up	Down
Pt (Watts)	0.10	2.00	2.00	1.00
Gt (dBi)	16.00	2.00	1.00	3.00
eirp	6.00	5.00	3.00	3.00
Ls(dB)	147.37	146.76	147.37	146.76
Lp(dB)	2.00	2.00	2.00	2.00
Lr(dB)	0.50	2.00	0.50	2.00
Gr(dB)	3.00	1.00	3.00	16.00
Carrier(dBW)	-140.87	-144.76	-143.8	7-131.76
Ts(K)	425.00	500.00	425.00	300.00
Gr/Ts (dB/K)	-23.28	-25.99	-23.28	-8.77
C/No (dBHz)	61.45	56.85	58.45	72.07
Rb (b/s)	8334.00	8334.00	4167.00	04167.00
Eb/No (dB)	22.24	17.64	22.25	35.87
C/No	61.45	56.85	58.45	72.07
Users CND	52.21	51.21	49.59	49.59
Channels CND	55.23	55.23	50.98	51.98
Interference CND	48.73	100.00	45.73	100.00
Composite	46.36	48.98	43.27	47.59
Up & Down	44.47		41.90	
Required Eb/No	2.3		2.3	
Required CND	43.51		40.50	
Margin	2.96		3.40	

TABLE A3. Starsys Link Analysis for 0.2 Erlang

Simult.Users	12
Forward channels	4
RF Band.(KHz)	1000
10 log (RF Band)	60 dB
Inter.Traffic (E)	0.2

	Forward		Return	
	Up	Down	Up	Down
Pt (Watts)	0.10	2.00	2.00	1.00
Gt (dBi)	16.00	2.00	1.00	3.00
eirp	6.00	5.00	3.00	3.00
Ls(dB)	147.37	146.76	147.37	146.76
Lp(dB)	2.00	2.00	2.00	2.00
Lr(dB)	0.50	2.00	0.50	2.00
Gr(dB)	3.00	1.00	3.00	16.00
Carrier(dBW)	140.87	-144.76	-143.87	-131.76
Ts(K)	425.00	500.00	425.00	300.00
Gr/Ts (dB/K)	-23.28	-25.99	-23.28	-8.77
C/No (dBHz)	61.45	56.85	58.45	72.07
Rb (b/s)	8334.00	8334.00	4167.0	04167.00
Eb/No (dB)	22.24	17.64	22.25	35.87
C/No	61.45	56.85	58.45	72.07
Users CND	52.21	51.21	49.59	49.59
Channels CND	55.23	55.23	50.98	51.98
Interference CND	46.13	100.00	43.13	100.00
Composite	44.67	48.98	41.61	47.59
Up & Down	43.30		40.63	
Required Eb/No	2.3		2.3	
Required CND	43.51		40.50	
Margin	1.79		2.13	

3. GRAPHICAL SUMMARY

In Orbcomm's comments on the STARSYS proposal, several graphs were presented which purport to show why the STARSYS system is unworkable. These graphs were based on system parameters presumed by Orbcomm. Using system parameters actually chosen by STARSYS, these curves can be redrawn to show the viability of the STARSYS system.

Uplink Margin

Orbcomm plots uplink margin as a function of the number of simultaneous interferers, showing a maximum margin of 7 dB with one 5-watt interferer. Using actual STARSYS parameters, the true curve shows an additional 10 dB of margin.

Probability Threshold

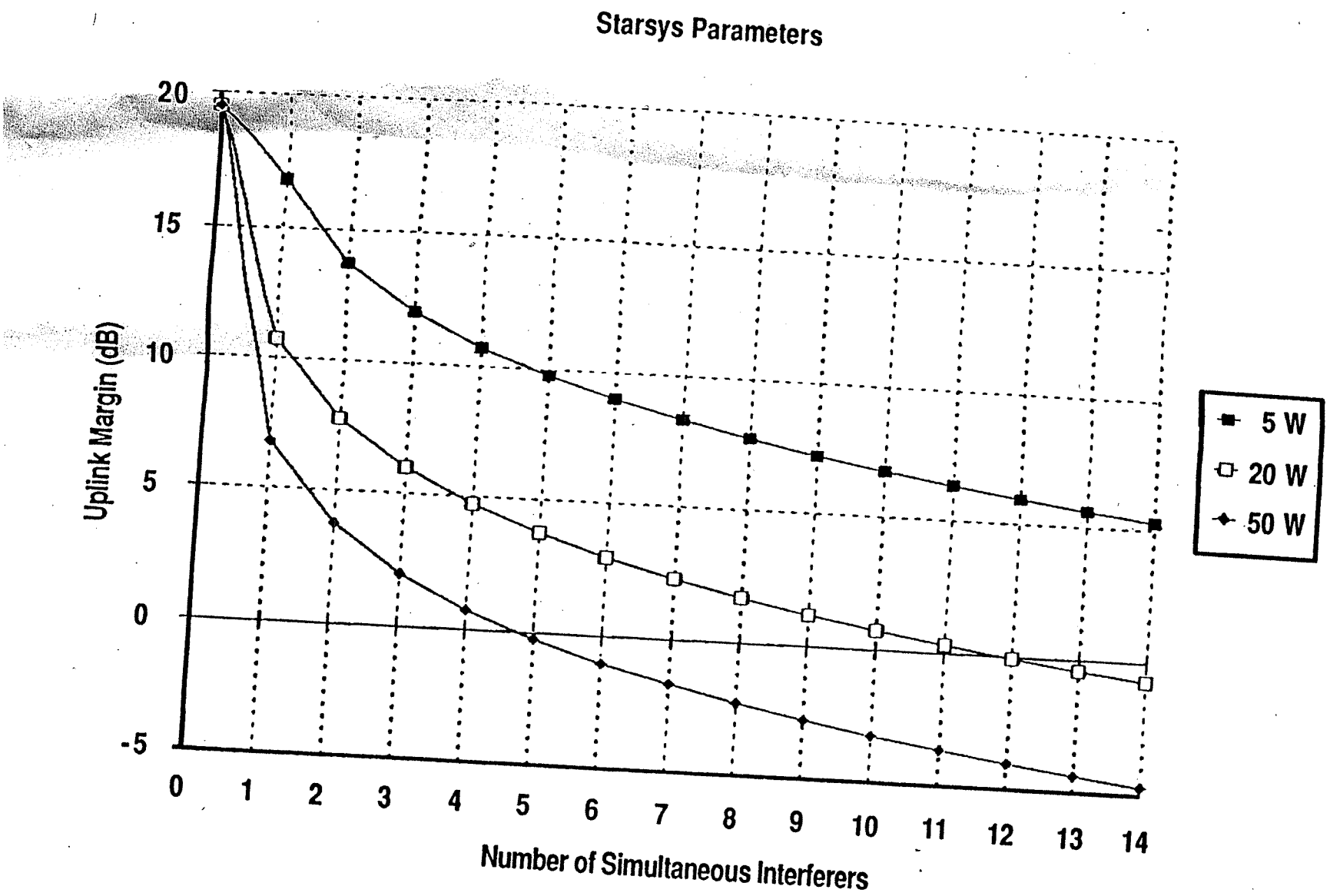
Orbcomm's graph shows a steadily increasing probability of exceeding the jamming threshold as the spreading bandwidth is increased. In reality, the probability of exceeding the jamming threshold decreases with increased spreading bandwidth.

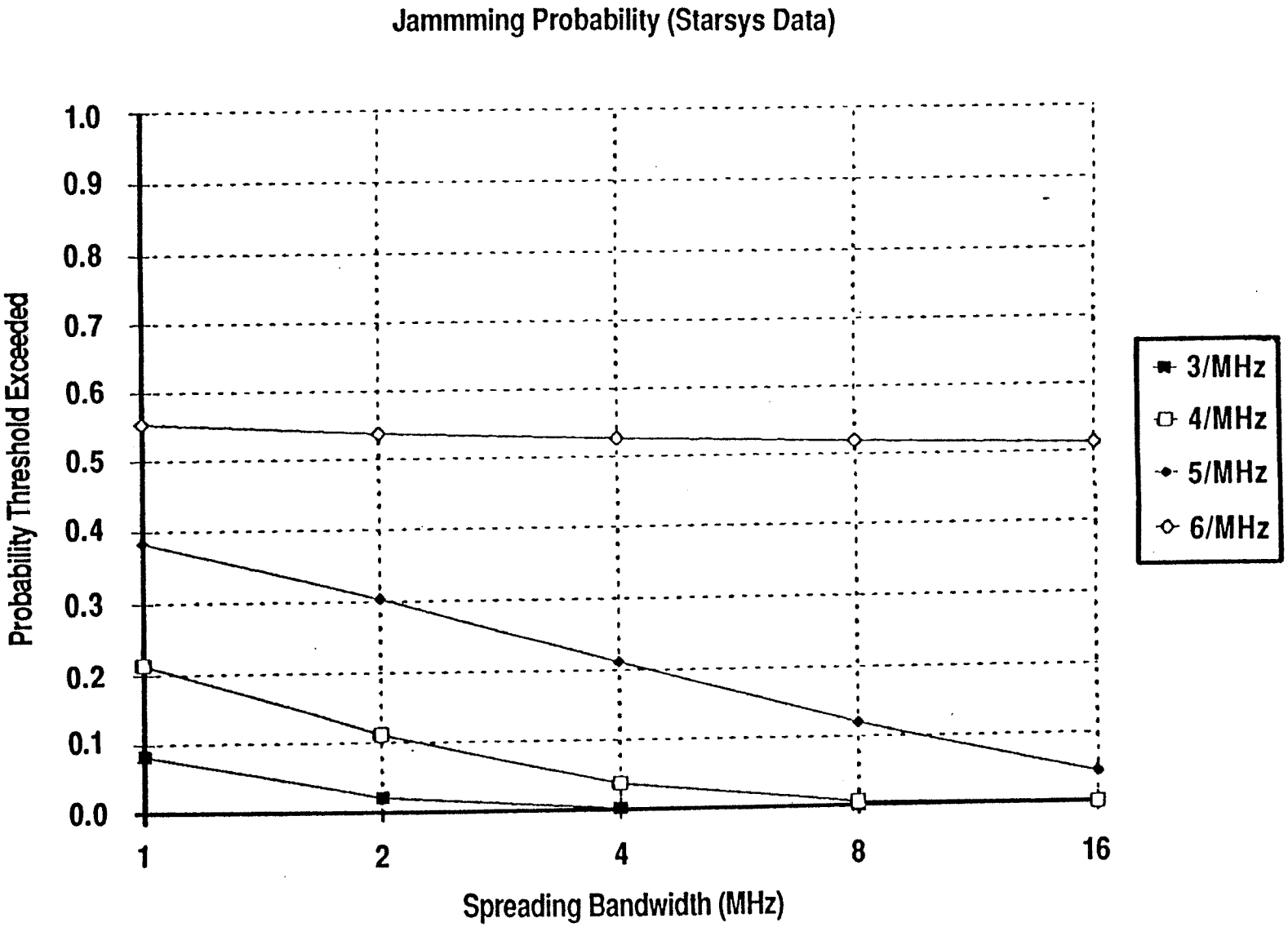
Uplink Margin vs. 50-Watt Interferers

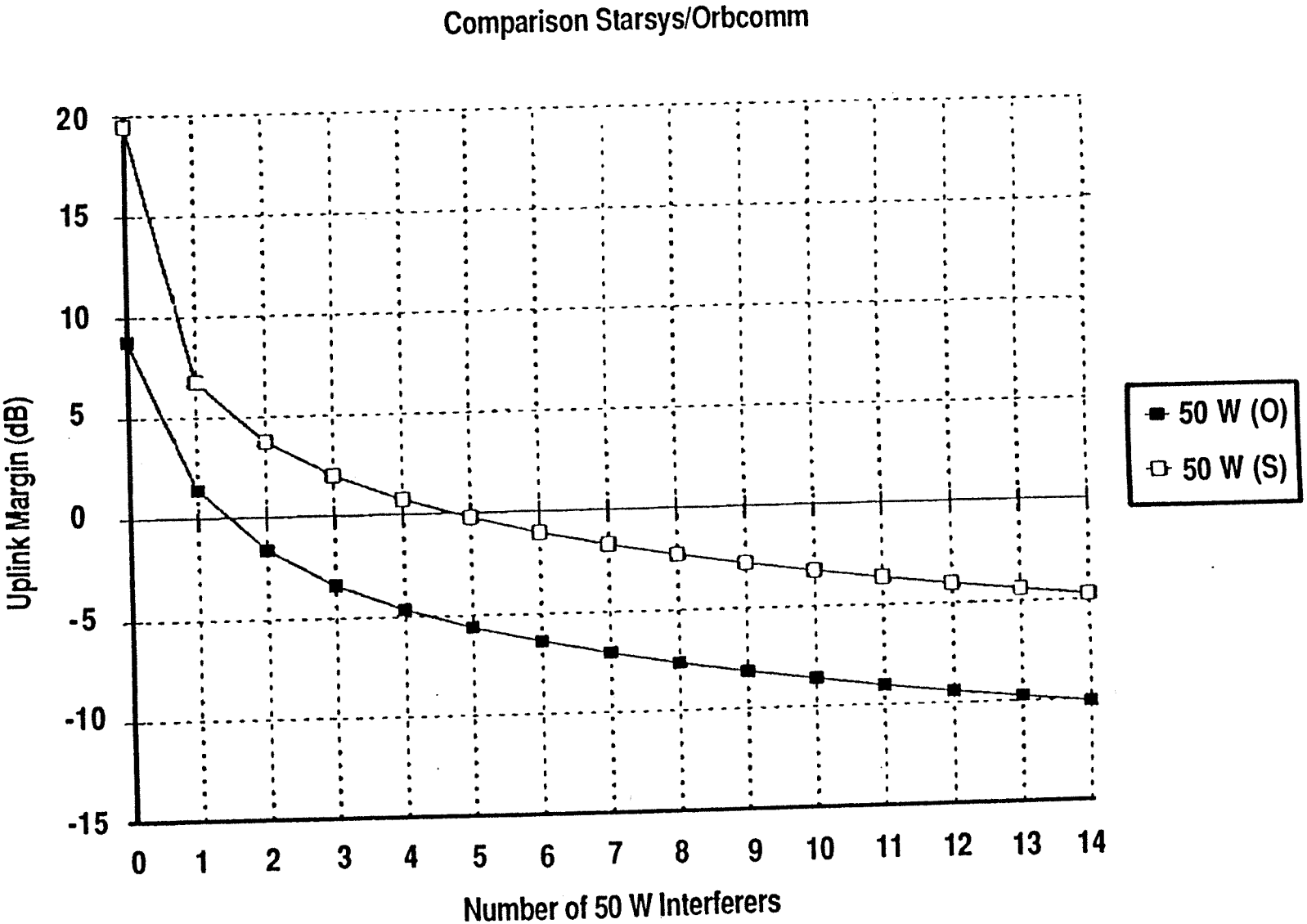
The computation of uplink margin as a function of number of 50-watt interferers is shown using both Orbcomm and STARSYS parameters. The STARSYS calculations indicate that the uplink margin is positive even with four 50-watt interferers.

4. CONCLUSION

STARSYS has presented information to clarify the details of its system which were not known or not properly interpreted by Orbcomm. The analysis presented here shows the STARSYS spread-spectrum LEO MSS proposal to be workable, efficient, and practical.


Starsys Parameters
Uplink Margin (dB)
20
15
10
5
0
-5
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Number of Simultaneous Interferers
5 W
20 W
50 W


Jammming Probability (Starsys Data)
Probability Threshold Exceeded
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1
2
4
8
16
Spreading Bandwidth (MHz)
3/MHz
4/MHz
5/MHz
6/MHz


Comparison Starsys/Orbcomm
Uplink Margin (dB)
20
15
10
5
0
-5
-10
-15
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Number of 50 W Interferers
50 W (O)
50 W (S)

APPENDIX C

TECHNICAL STATEMENT

In its comments, ORBCOMM alleges that STARSYS is not qualified legally, technically, or financially to construct or operate a Low Earth Orbiting Satellite communication system. This paper will refute ORBCOMM's technical claims and respond to certain comments made by Geosar Corporation.

A. Response to ORBCOMM

STARSYS has defended its spread-spectrum technique in a technical appendix to a rebuttal of ORBCOMM's earlier claims. The Technical Statement attached to STARSYS' August 17, 1990, Reply Comments in RM-7399, clearly demonstrates positive operating margin of the STARSYS system pseudo-noise spread-spectrum LEO MSS system even in the face of worst-case self-interference and interference from land-mobile communication systems. The key table from that document, "Link Analysis for 0.2 Erlang", updated for clarity, is attached to this statement. It shows approximately 2 dB of operating margin with worst-case self-interference and 0.2 Erlang of interfering traffic.

Regarding orbit selection and station keeping, STARSYS' intentions appear to have been misinterpreted. While the 60-degree inclination orbital planes will at first be selected at random, clearly the satellites launched later must be more carefully placed to avoid gaps in coverage.

Because the orbital location of each satellite will be monitored from the ground, and because gravitational precession will affect all orbits equally, it is not necessary that the spacecraft maintain a "station". Station keeping is more important for geostationary satellites whose orbits are such that the satellite is supposed to stay at or near a location in space directly above a specific point on the earth. For a constellation of satellites which are supposed to move relative to the earth, small drifts of the entire constellation are of little or no consequence.

ORBCOMM claims that another flaw in the STARSYS system is its "dependency on polling as the sole method of communicating with the user terminals". Evidently ORBCOMM did not understand the concept of STARSYS' low-cost user terminals. The "LOCPAC"^{tm} terminal is a transmit-only terminal for one-way pre-programmed transmission to a Processing, Analysis, and Control Center. A transmit-only terminal cannot be polled. Of the other types of user terminals proposed by STARSYS, only the "DATAPAC"^{tm}, two-way data collection and location terminal would be subject to polling. Polling the "KEYPAC"^{tm} two-way communications terminals would be as ludicrous as having the telephone company call up to ascertain one's readiness to make a telephone call!

B. Response to Geostar

Geostar misuses the system capacity and projected market estimates to hypothesize unrealistic looking message intervals. In truth, given appropriate models for expected typical use of the STARSYS system, there is more than adequate communication capacity. System capacity is more fully examined in the Technical Statement attached to STARSYS' August 17, 1990, Reply Comments in RM-7399.

The STARSYS LEO MSS system will provide a user-locating service accurate to within a kilometer for a single measurement. Greater accuracies are obtained with the passage of time and repeated measurements. Geostar is correct that STARSYS' accuracy for such measurements does not exceed that of Geostar, but STARSYS can offer the equivalent service at much lower cost.

Link Analysis for 0.2 Erlang

Simult.Users	12
Forward channels	4
RF Band.(KHz)	1000
10 log (RF Band)	60 dB
Inter.Traffic (E)	0.2

	Forward		Return	
	Up	Down	Up	Down
Pt (Watts)	0.10	2.00	2.00	1.00
Gt (dBi)	16.00	2.00	1.00	3.00
eirp	6.00	5.00	3.00	3.00
Ls(dB)	147.37	146.76	147.37	146.76
Lp(dB)	2.00	2.00	2.00	2.00
Lr(dB)	0.50	2.00	0.50	2.00
Gr(dB)	3.00	1.00	3.00	16.00
Carrier(dBW)	140.87	-144.76	-143.87	-131.76
Ts(K)	425.00	500.00	425.00	300.00
Gr/Ts (dB/K)	-23.28	-25.99	-23.28	-8.77
CND (dBHz)	61.45	56.85	58.45	72.07
Rb (b/s)	8334	8334	4167	4167
Eb/No (dB)	22.24	17.64	22.25	35.87
$(CND)_0$	61.45	56.85	58.45	72.07
Users $(CND)_1$	52.21	51.21	49.59	49.59
Channels $(CND)_2$	55.23	55.23	50.98	51.98
Interference $(CND)_3$	46.13	100.00	43.13	100.00
Composite	44.67	48.98	41.61	47.59
Up & Down	43.30		40.63	
Required Eb/No	2.3		2.3	
Required CND	41.51		38.50	
Margin	1.79		2.13	

ENGINEERING CERTIFICATE

The undersigned hereby certify that we are the technically qualified persons responsible for the preparation of the engineering information contained in the foregoing Technical Statement in support of the Reply Comments of STARSYS, Inc. to the comments of Orbital Communications Corporation and Geostar Corporation, and that we have prepared the foregoing Technical Statement. Further, we certify, under penalty of perjury, that the Technical Statement is complete and accurate to the best of our knowledge.

Marvin I. Senter
Engineering Manager
STARSYS, Inc.

Ken Newcomer
Chief Engineer
STARSYS, Inc.

August 31, 1990

DECLARATION

I, Ashok Kaveeshwar, President of STARSYS, Inc., hereby declare under penalty of perjury that I have reviewed the foregoing document, including its appendices, and have found it to be true and correct to the best of my belief. Executed on September 4, 1990.

Ashok Kaveeshwar
President, STARSYS, Inc.

CERTIFICATE OF SERVICE

I, Katharine K. Bryant, do hereby certify that a copy of the foregoing "Reply Comments of STARSYS, Inc." was mailed, United States first-class postage prepaid, this 4th day of September 1990 to the following:

Gilles Galerne
President
LTM Corporation of America
11646 Pendleton Street
Sun Valley, CA 91352-2501

Vincent J. Cardone
President
Oceanweather, Inc.
5 River Road
Suite 1
Cos Cob, CT 06807

Kennon D. Vaudrey
President
Vaudrey & Associates, Inc.
1540 Marsh Street
P.O. Box 725
Suite E
San Luis Obispo, CA 93406

A. George Mourad
Manager
Space Business Development
Battelle
507 King Avenue
Columbus, OH 43201

Peter A. Castruccio
President
Ecosystems International, Inc.
Box 225
Gambrills, MD 21054

R. Michael Laurs, Ph.D.
Fishery Oceanographer
United States Department of Commerce
National Oceanic and Atmospheric Administration
South West Fisheries Science Center
P.O. Box 271
La Jolla, CA 92038-0271

Ralph Koch
Partner
KPMG Peat Marwick
8150 Leesburg Pike
Suite 800
Vienna, VA 22182

Charles Porter
Chief Executive Officer
Houston Data Transmission Company, Inc.
712 River Oaks Bank Tower
2001 Kirby Drive
Houston, TX 77019

J. K. English
English Automotive, Ltd.
1650 Howard Street
Lincoln Park, MI 48146

Linda M. Wellstein, Esq.
COMSAT Corporation
950 L'Enfant Plaza
Washington, D.C. 20024
Counsel for Communications Satellite Corporation, World Systems Division

T. Stephen Cheston
Executive Vice President
Governmental Affairs
Geostar Corporation
1001 22nd Street, N.W.
Suite 500
Washington, D.C. 20037

Albert Halprin, Esq.
Stephen L. Goodman, Esq.
Verner, Liipfert, Bernhard, McPherson & Hand, Chartered
901 Fifteenth Street, N.W.
Suite 700
Washington, D.C. 20005
Counsel for Orbital Communications Corporation

Katharine K. Bryant