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

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OFFICE OF THE SECRETARY

In the Matter of	)	
	)	
Redesignation of the 17.7-19.7 GHz	)	
Frequency Band, Blanket Licensing of	)	
Satellite Earth Stations in the 17.7-20.2 GHz	)	IB Docket No. 98-172
and 27.5-30.0 GHz Frequency Bands, and the	)	RM-9005
Allocation of Additional Spectrum in the	)	RM-9118
17.3-17.8 GHz and 24.75-25.25 GHz	)	
Frequency Bands for Broadcast Satellite-	)	
Service Use	)	

COMMENTS OF HUGHES ELECTRONICS, INC.

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Summary

Hughes supports the Commission's proposal to segment the 17.7-19.7 GHz band between satellite and terrestrial users and to develop an efficient means for blanket licensing large numbers of small Ka band satellite earth stations. These two actions are critical to the deployment of GSO FSS broadband satellite systems that will be capable of providing competitive alternatives to terrestrial networks.

In pursuing these two main objectives, Commission should be guided by three core principles: (i) facilitate the prompt deployment of satellite-based alternatives to terrestrial broadband systems; (ii) encourage the use of advanced satellite technology that maximizes service capabilities and minimizes cost to consumers; and (iii) provide for the development of even more advanced satellite technologies in the future.

GSO FSS satellite systems provide the opportunity to meet the broadband needs of a large number of consumers and businesses who never will be adequately served by terrestrial providers. But in order to provide a competitive alternative to terrestrial networks, GSO FSS systems need access to a full 1000 MHz of Ka band spectrum for use by ubiquitous earth stations. This need was established in the 28 GHz proceeding and continues to be supported by the unprecedented growth in demand for broadband capacity and declining prices for that same capacity.

The current band plan proposal accommodates only 75% of the downlink bandwidth needs of the GSO FSS. However, there is no reason to think that either GSO FSS sharing obligations in the uplink band, or "space science service" regulatory constraints in part of the downlink band, in any way reduce the need for 1000 MHz of downlink spectrum for use by

ubiquitous earth stations. Thus, Hughes urges the Commission to consider an alternate approach that provides a more equitable distribution of spectrum, based on the following considerations:

(1) GSO FSS operators need access to an additional 500 MHz of contiguous spectrum for downlinks to small, ubiquitous terminals;

(2) NGSO FSS operators need 500 MHz for downlinks to small, ubiquitous terminals;

(3) BSS operators need access to 100 MHz for service links to small DTH antennas;

(4) The 18.6 - 18.8 GHz band cannot be used for FSS service to small, ubiquitous terminals, absent a suitable relaxation of the pfd limit there that protects the space sciences;

(5) The 17.7 - 17.8 GHz band is uniquely suited for BSS downlink needs due to the international allocation for that band;

(6) In light of consideration (4), the 500 MHz of contiguous GSO FSS spectrum may need to be met in the 17.8 - 18.6 GHz range; and

(7) It is unfair and inequitable to place the burden of this band plan, if there is to be a burden, only upon the GSO FSS and BSS industries by failing to meet their needs.

The Commission historically has provided satellite operators great flexibility to deploy satellite systems that can meet the needs of the ever-evolving market, and traditionally has declined to constrain the use of new bands, such as the Ka band. While blanket licensing is critical to the deployment of ubiquitous small earth stations at Ka band, Hughes urges the Commission to also take into account the needs of other potential uses of the Ka band, such as the provision of DTH video service to the public.

Moreover, an important touchstone in developing appropriate blanket licensing criteria should be the preservation of flexibility for future developments and innovations in technology. While blanket licensing is critical to allow the rollout of the first generation Ka band systems, the blanket licensing rules also must support the deployment of future generations of Ka band systems that will capitalize on advances in technology that are not available today.

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In the Matter of Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3-17.8 GHz and 24.75-25.25 GHz Frequency Bands for Broadcast Satellite-Service Use	))))))))))	IB Docket No. 98-172 RM-9005 RM-9118

COMMENTS OF HUGHES ELECTRONICS, INC.

Hughes Electronics, Inc., individually and on behalf of its subsidiaries, Hughes Communications, Inc., Hughes Communications Galaxy, Inc. and Hughes Network Systems, Inc. ("Hughes") hereby submits its Comments in response to the Commission's Notice of Proposed Rulemaking[1] in the above-referenced proceeding. Hughes is vitally interested in this proceeding as Hughes Communications Galaxy, Inc. is the FCC licensee of the SPACEWAY Ka band satellite system, Hughes Communications, Inc. is an applicant in the second Ka band processing round for the Spaceway EXP and Spaceway NGSO satellite networks,[2] and Hughes Network

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1 *Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3-17.8 GHz and 24.75-25.25 GHz Frequency Bands for Broadcast Satellite-Service Use*, FCC 98-235 (rel. September 18, 1998) ("NPRM").

2 Two Hughes Electronics affiliates, PanAmSat Corporation and DIRECTV Enterprises, Inc., are separately filing comments in this proceeding.

Systems, Inc. is a leading manufacturer of small Ku band earth stations ("VSATs") and a provider of VSAT satellite services.

At the outset, Hughes lauds the Commission for its initiative and effort in putting forth the NPRM. Hughes agrees that both blanket licensing of satellite earth stations, and band segmentation between ubiquitously-deployed satellite earth stations and fixed terrestrial stations, are necessary at Ka band. Indeed, the development of an efficient earth station licensing mechanism is a vital step toward facilitating the deployment of GSO FSS broadband satellite systems. In pursuing its twin objectives in the NPRM, the Commission should be guided by three core principles: (i) facilitate the prompt deployment of satellite-based alternatives to terrestrial broadbased systems; (ii) encourage the use of advanced satellite technology that maximizes service capabilities and minimizes cost to consumers; and (iii) provide for the development of even more advanced satellite technologies in the future. As noted below, Hughes supports many of the Commission's proposals, but believes that others need to be modified to achieve these goals.

I. HUGHES BROADBAND VISION

Hughes is uniquely qualified to assess and comment on the many issues raised in the NPRM, and the factors that are critical for success in the rapidly growing and quickly changing broadband market. Over five years ago, Hughes envisioned the development of a broadband service -- SPACEWAY -- that would extend the capability and customer base of the traditional Ku band VSAT market. Since Hughes filed the SPACEWAY application that started the 1995 Ka band processing round, technological developments and customer demand have reinforced Hughes's vision of the role that satellites can play in the broadband market, but this requires, of course, that adequate bandwidth remains available for the provision of service to ubiquitous earth terminals.

Hughes has a proven track record in the satellite communications business, including unrivaled experience in:

- Satellite Design and Manufacture: Hughes started the commercial satellite industry and has delivered a significant number of the GSO satellites that currently serve the world. Hughes continues to lead the industry in developing cutting-edge technology and applying it in state of the art satellites.

- Earth Station Network Design and Implementation: Hughes started the Ku band VSAT industry over 15 years ago and has manufactured and installed over 150,000 VSAT terminals worldwide. Thus, Hughes is well-situated to understand the effect of antenna size and user terminal cost on the types and breadth of applications that can be served at Ka band by small antennas.

- Satellite Services: Hughes created the satellite transponder leasing industry over 15 years ago and continues a leadership role through its 81% ownership of PanAmSat, which operates a global network of spacecraft. This experience has provided Hughes with an intimate understanding of the issues affecting customer satisfaction, such as competitive pricing and quality of service. Recently, Hughes led the development of the DBS business in the U.S. with introduction of DIRECTV service, which serves millions of consumers through ubiquitously deployed mass-market terminals about 18 inches in diameter. HNS is a leading VSAT service provider.

This experience gives rise to the Hughes vision of providing a competitive, broadband service alternative through the SPACEWAY Ka band satellite network. SPACEWAY will incorporate the most advanced, digital technology and thereby will provide an evolutionary path for the rest of the satellite industry over time. The system is configured to (i) address the explosive growth in demand for Internet, corporate intra/extranets, distance learning, trunking, e-mail, telemedicine, electronic commerce, voice, and videoconferencing, among other services, and (ii) thereby meet the needs of large enterprises, small office/home office (SOHO) users, and consumers. SPACEWAY will provide a unique opportunity to serve the entire United

States, and address the needs of those who do not have, and may never have, access to terrestrial broadband services, including many households and small businesses.

II. GSO FSS Systems Need at Least 1000 MHz of Unencumbered Spectrum for Use by Blanket-Licensed Small Terminals

From the early phases of the 28 GHz proceeding, both Hughes and the Commission have recognized that the then-proposed, and now-licensed, GSO FSS satellite systems would require access to at least 1000 MHz of Ka band spectrum to provide high capacity service to the broadest possible range of users through inexpensive, ultra small aperture satellite terminals ("USATs") that can be deployed ubiquitously.[3] Indeed, when Hughes initially proposed the SPACEWAY system in December 1993, a fundamental premise of the proposal was that in order to meet demand for high capacity services and be commercially viable, the system needed access to at least 1000 MHz of Ka band spectrum for use by ubiquitous USATs. Nothing has occurred in the past five years to alter Hughes' market assessment or reduce its spectrum requirements. Only two years ago, and as part of a carefully crafted compromise, the Commission committed to provide 1000 MHz of paired spectrum that would support the needs of the broadband systems of GSO FSS operators, such as Hughes' SPACEWAY system.[4] In the ensuing two years, two developments have further confirmed and strengthened Hughes'

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3 *In the Matter of Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5 - 29.5 GHz Frequency Band, to Reallocate the 29.5 - 30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*, 11 FCC Rcd 53, ¶¶ 54,55 (1995) ("28 GHz NPRM").

4 *In the Matter of Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5 - 29.5 GHz Frequency Band, to Reallocate the 29.5 - 30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services*, 11 FCC Rcd 19005, ¶¶ 57-58, 78 (1996) ("28 GHz Report and Order").

conclusion that access to a full 1000 MHz of unencumbered spectrum is absolutely essential for broadband GSO satellite systems at Ka band: unprecedented growth in demand for broadband capacity and declining prices for that same capacity.

First, everyone has witnessed the explosive worldwide growth in the Internet and multimedia communications. It is the same high-capacity, broadband applications that are fueling the growth of the Internet that are driving the demand for high-speed, high-capacity data transport services. The demand for data transport is estimated to be growing at a compounded annual rate of more than 50% through 2002 and beyond. In order to meet this demand on a price-competitive basis, satellite systems at Ka band continue to need 1000 MHz to serve ubiquitous, small terminals.

The second marketplace development further fueling the need for 1000 MHz is the declining price of data transport services. By 2005, the price per megabit for broadband services is expected to decline by at least two-thirds. The competition that is driving this development is good news for the public: faster speeds and greater capacity are available at decreasing prices and the choice of service providers continues to grow. However, this development also means that broadband satellite services will face fierce competition in the new broadband market from many other service providers, including terrestrial services such as DSL, fiber optics, cable modems and wireless local loop technologies. As a general matter, economists expect the broadband market to demonstrate the highly sensitive price elasticity of demand present in most communications markets today. Thus, the ability of satellite services to compete in the broadband market will turn in large part on the cost of the services they provide, as well as the cost of the consumer equipment needed to receive the services. One need only to look at the pricing packages for the coming DSL services in Washington, D.C. to realize that the broadband market will not support large service or consumer equipment costs.[5]

Hughes' SPACEWAY business case relies, and has always relied, on the ability to successfully provide an end-to-end service to both businesses and consumers (including telecommuters and small office/home office users). A cutting edge, innovative system, such as SPACEWAY, can flourish only if it can successfully serve a broad-based market at a price that is affordable, and with a level of quality and performance that is competitive with terrestrial service alternatives. The competitive implementation of satellite-based broadband services is highly dependent on the ability to deploy a very large number of small, inexpensive, self-installable user terminals instead of some form of "gateways," which by definition are not accessible to small businesses and consumers.

Two primary factors drive the cost to the user of the SPACEWAY service: the amount of bandwidth available to the system and user equipment costs. As a practical matter, capital costs have to be spread across all users of a system. Any reduction in bandwidth would reduce the number of users that can be served and therefore would drive up the cost of the service per user. Second, user equipment costs, specifically the cost of the satellite earth terminal, are driven both by the size of the terminal, as well as its performance characteristics and those of the associated satellite. Among other things, small dishes reduce installation costs and, as the Commission is well aware, minimize zoning disputes. Hughes' experience in providing satellite services to consumers and small businesses over the last 15 years shows the needs of these users

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5 *See Infospeed DSL Pricing* (visited November 19, 1998) <http://www.bell-atl.com/adsl/more_info/pricing.html> (introductory offer providing DSL modem and turnkey home installation for $99 with 12 month service subscription).

are best met through small, easily installed, and inexpensive earth terminals. And as set forth below, the terms on which these terminals are blanket licensed have a direct impact on the cost to the user.

Based upon the business case and market realities discussed above, and on the Commission's 28 GHz band plan, Hughes has designed a satellite system that efficiently utilizes all 1000 MHz of Ka-Band spectrum for links to and from small, ubiquitously deployed earth terminals. Hughes' need for 1000 MHz of both uplink and downlink spectrum has remained constant since SPACEWAY was first proposed five years ago. Spurred in part by the developments in the marketplace, but also in large measure by the Commission's grant of the SPACEWAY license in May 1997, Hughes is well on the way to implementing its 1000 MHz SPACEWAY system. SPACEWAY is one of the key elements to Hughes' future growth as a company and Hughes' business plan, funding and design decisions have been made at the highest levels.

Given that the SPACEWAY design and business plan have always been based on use of a full 1000 MHz spectrum for ubiquitous service, the proposal in the NPRM to reduce the available bandwidth to 750 MHz has the effect of rendering useless 25% of the design capacity of the SPACEWAY system. SPACEWAY always has been designed to support 500 MHz of capacity on a single satellite and to use two spacecraft at an orbital location to use the full 1000 MHz of available bandwidth. Thus, such a 25% reduction in bandwidth also raises serious questions about the cost-effectiveness of any investment in a second satellite at a given location that would have access to only 250 MHz of spectrum for ubiquitous terminals. Of course, this severe reduction in useable capacity would have a material and significant impact on the cost to users of the SPACEWAY system, particularly in the small business and consumer markets, where lower service and equipment costs are critical. Hughes therefore urges the Commission to consider the significant adverse impact of its proposal on small businesses and consumers.

The Ka band provides the first real opportunity to provide affordable two-way, broadband satellite services directly to consumers and small businesses, particularly for users who are not now served, and never may be served, by terrestrial broadband service providers. Indeed, GSO FSS satellite systems will be the only technology available for a significant portion of the small businesses and consumers in the U.S.

Terrestrial broadband deployment will be highly focused in the near term on larger businesses, metropolitan areas and affluent suburbs. Several consultants have estimated that, even by 2010, the metropolitan focus of terrestrial broadband deployment will leave 30 - 40% of U.S. consumers and small businesses without access to terrestrial broadband service. GSO FSS broadband satellite systems offer the only viable way to serve the users who are and will be unserved by terrestrial broadband. The proposed band plan risks sacrificing the interests of these users in favor of a single "gateway" based system that would serve users who already have satellite and other telecommunications service choices and whose needs are less cost sensitive than small businesses and consumers.

In fact, there is no reason to believe that the trend at Ka band will be toward anything other than 66 cm antennas that virtually anyone can install at his or her home, school or business. Thus, eliminating one-fourth of the GSO FSS Ka band spectrum for the most compelling user needs would be bad public policy. Moreover, as set forth below, there is no reason to constrain the GSO industry in this manner.

III. THE COMMISSION'S BAND SEGMENTATION PROPOSAL IS BASED UPON TWO FALSE PREMISES

Indeed, the Commission's commitment to provide 1000 MHz of spectrum is central to Hughes' ability to provide broadband FSS services at Ka band. Hughes is gravely concerned that the NPRM appears to depart in two substantial and unwarranted ways from the Commission's original commitment to the GSO industry.

First, by designating 250 MHz of the GSO FSS downlink spectrum for co-primary, shared FSS/FS use, the Commission's proposal, admittedly,[6] would limit to 750 MHz the amount of spectrum available to GSO FSS systems for deployment of small, ubiquitous terminals. This proposal, if adopted, would undercut the careful compromise that led to the resolution of the 28 GHz proceeding. Obviously, the proposal would also effectively reduce by 25% the capacity of Hughes' SPACEWAY system for its intended markets -- large businesses, small businesses and consumers. As noted above, any such reduction in capacity would materially affect the economics of this service and the price at which this service could be provided to consumers.

The Commission based this tentative decision primarily on the plan of a single GSO FSS licensee, Lockheed Martin, to use 500 MHz within the 17.7 - 18.8 GHz band for a limited number of larger "gateway" terminals.[7] And in doing so, the Commission ignored the well-established need for the GSO FSS to have access to 1000 MHz for use by small terminals. Limiting GSOs to 750 MHz for small terminals was proposed and soundly rejected in the 28

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6 NPRM at ¶ 32.

7 *Id.*

GHz proceeding over three years ago and there is no reason to reconsider that proposal now.[8] Moreover, the Commission cannot ignore the established spectrum needs of SPACEWAY and the other GSO systems.

The Commission's other stated reason for reducing the useable GSO FSS downlink spectrum to 750 MHz is the pfd limit currently applicable in the 18.6 - 18.8 GHz band.[9] Here the Commission simply has put the proverbial cart before the horse. The existence of this pfd limit and its preclusive effect on the deployment of small earth stations is one of the reasons the Commission provided the ability for GSO FSS systems to satisfy their 500 MHz of the downlink needs within the 17.7 - 18.8 GHz band.[10]

In other words, the existence of the pfd limit in the 18.6 - 18.8 GHz band is a reason the Commission originally planned to allow GSO FSS operators to locate downlinks for their small terminals elsewhere, in the 17.7 - 18.6 GHz band. It is not a reason to limit access to 250 MHz of critical spectrum to "gateway" operations. Rather, absent a change in the current pfd limit in the 18.6 - 18.8 GHz band, the preclusive effect that this limit has upon satellite operations[11] would be a compelling reason to make that band available for terrestrial fixed

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8 *See* Hughes Communications Galaxy, Inc. *Ex Parte* Presentation, CC Docket 92-297 (filed July 6, 1995) at 3 ("staff proposal . . . restricting 250 MHz . . . to non-VSAT"); Reply Comments of Hughes Communications Galaxy, Inc., CC Docket 92-297 (filed October 10, 1995) at 5.

9 NPRM at ¶ 32.

10 28 GHz Report and Order at ¶ 78.

11 US footnote 255 provides that "the fixed satellite service shall be limited to a power flux density at the Earth's surface of -101 dBW/m^2 in a 200 MHz band for all angles of arrival." 47 C.F.R. § 2.106 (1997). This pfd limit is equivalent to -124 $dBW/m^2/MHz$. As set forth below, Hughes advocates a pfd coordination threshold of -118 $dBW/m^2/MHz$ for USAT Ka band blanket licensing. Thus, blanket licensed USATs will well exceed the current power limit designed to protect the space sciences.

service use and to accommodate ubiquitous GSO FSS terminals elsewhere in the Ka band. While Hughes would certainly support a relaxation of this pfd limit to a level that would permit the successful deployment of small ubiquitous terminals in this band,[12] the GSO FSS community will need appropriate assurances that such a change actually will be implemented before it could rely on the ability to use this band.

The Commission's tentative decision not to permit blanket licensing of ubiquitous GSO FSS terminals in the 29.25 - 29.5 GHz uplink band is a further unwarranted departure from its original commitment to provide 1000 MHz of paired spectrum for GSO FSS operators. This tentative decision would reduce the uplink spectrum available for small, ubiquitously deployed FSS earth stations to 750 MHz. Of course, individual coordination of a large number of small GSO FSS earth stations with the MSS feeder link stations in the wide service area contemplated -- even if technically feasible -- would jeopardize the economic feasibility of the types of broadband FSS networks that the Commission has licensed at Ka band. The Commission's apparent premise for its tentative decision to exclude blanket licensing in this 250 MHz band is that the current compromise GSO FSS/MSS feeder link sharing arrangement reflected in the Commission's rules is in some way incompatible with "future mobile satellite systems."[13] This premise is directly contradicted by the record in the 28 GHz band plan proceeding and is simply incorrect, as described below.

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12 While NASA and other U.S. government representatives have expressed some willingness to relax the pfd limit in the 18.6 - 18.8 GHz band, there is no certainty that these proposals will be adopted either domestically or internationally.

13 NPRM at ¶ 63.

One of the fundamental compromises that led to the consensus 28 GHz band plan was an agreement to designate two different parts of the Ka band for MSS feeder link use. One band -- 29.1 - 29.25 GHz -- was designated for MSS systems, like Iridium, that are not designed to share spectrum with FSS GSO systems. The other band -- 29.25 - 29.5 GHz -- was to be shared, with very few operational constraints, between FSS GSO systems utilizing ubiquitously deployed earth stations and MSS systems designed to share with these FSS systems, such as the former Odyssey system.[14] The GSO FSS/MSS feeder link sharing regime that was developed through the efforts of TRW/Odyssey and Hughes, as well as other GSO FSS operators, was an integral part of the negotiations that ultimately permitted the industry-wide consensus band plan.

Even though TRW has decided not to pursue the Odyssey system,[15] the 29.25 - 29.5 GHz band remains available for "future mobile satellite systems" that are designed to share with FSS GSO systems utilizing ubiquitously deployed earth stations. Indeed, the Commission recognized this in adopting the sharing plan.[16] As Hughes has stated before in the 28 GHz band plan proceeding, "the NGSO MSS/GSO FSS sharing solution adopted by the Commission . . . works for Odyssey and also will work for other systems that may be proposed in the future, as long as those systems include in their architecture design elements that make them susceptible to sharing."[17] Technical Appendix A contains a discussion demonstrating the continued feasibility of sharing between a GSO FSS system like SPACEWAY and an MSS system that is designed to

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14 *See* 28 GHz Report and Order at ¶¶ 69, 72.

15 *See ICO and Odyssey End Patent Dispute; TRW Gets $150-Million Stake*, Communications Daily, December 18, 1997.

16 *See* 28 GHz Report and Order at ¶ 74.

17 *Opposition of Hughes Communications Galaxy, Inc. to Petition for Reconsideration and Comments on Petition for Clarification*, Docket 92-297, at 6-7 (filed October 21, 1996).

share spectrum. As noted therein, this sharing arrangement is wholly independent of the size or the number of ubiquitous GSO FSS uplink terminals in the band.

IV. SEGMENTATION ALTERNATIVES

As discussed above, the Commission's tentative band segmentation proposal has several serious shortcomings. Foremost among these problems is the Commission's revisitation of its original decision to accommodate the need of the GSO FSS operators for 1000 MHz of spectrum. The Commission's tentative decision to reduce the spectrum available for small, ubiquitous GSO FSS earth stations would have a substantial adverse impact on the business plans that Hughes, and undoubtedly other GSO FSS licensees, have developed in reliance upon the 28 GHz band plan. While Hughes cannot, at this time, propose an ideal band plan that would accommodate all interested parties, it is clear that a new band plan for the 17.7 - 19.7 GHz band needs to be considered based upon the following premises:

(1) GSO FSS operators need access to an additional 500 MHz of contiguous[18] spectrum for downlinks to small, ubiquitous terminals;[19]

(2) NGSO FSS operators need 500 MHz for downlinks to small, ubiquitous terminals;

(3) BSS operators need access to 100 MHz for service links to small DTH antennas;[20]

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18 Use of a contiguous 500 MHz of downlink spectrum permits communication system designs that provide more cost effective operation. As noted above, the continuing rapid growth of multimedia applications is driving the need for greater bandwidth. Access to a contiguous 500 MHz is critical to allow all satellite operations to employ advanced satellite technology that enables higher data rate services and the flexibility to optimize the satellite transmission system to support those applications.

19 The 19.7 - 20.2 GHz band already is available for such terminals.

20 *See* Comments of DIRECTV Enterprises, Inc. in IB Docket 98-172 (filed November 19, 1998).

(4) The 18.6 - 18.8 GHz band cannot be used for FSS service to small, ubiquitous terminals, absent a suitable relaxation of the pfd limit there that protects the space sciences;

(5) The 17.7 - 17.8 GHz band is uniquely suited for BSS downlink needs due to the international allocation for that band;[21]

(6) In light of consideration (4), the 500 MHz of contiguous GSO FSS spectrum may need to be met in the 17.8 - 18.6 GHz range; and

(7) It is unfair and inequitable to place the burden of this band plan, if there is to be a burden, only upon the GSO FSS and BSS industries.

On this last point, under the Commission's proposal, of the satellite interests, it is only the GSO FSS and the BSS whose spectrum requirements are not fully met by the current band plan proposal. The licensed NGSO FSS system has indicated that it needs 500 MHz of spectrum for downlinks to small, ubiquitous terminals. The Commission's proposal fully meets that requirement. MSS systems have articulated a need for feeder link access to the 19.3 - 19.7 GHz band, and those requirements continue to be met in full. Moreover, under the Commission's proposal, the terrestrial services retain full access to (i) 600 MHz of primary spectrum, (ii) virtually unfettered access to 400 MHz that is shared today with only two MSS feederlink complexes in the United States, and (iii) 250 MHz in a band in which GSO FSS systems would be substantially constrained by a prohibition on the deployment of ubiquitous small earth stations.

In contrast, the Commission's proposal would not provide sufficient clear spectrum required for GSO FSS and also fails to accommodate the BSS in the 17.7 - 17.8 GHz

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21 *Id.*

band.[22] There is no easy solution to this problem, but instead of the proposed approach, Hughes urges the Commission to rebalance the interests of all affected services based on a principle of proportionate burden sharing among all the services in developing an alternative solution. To that end, and at the risk of repetition, any reduction below 1000 MHz of GSO FSS downlink spectrum for small, ubiquitous terminals will have a significant adverse impact on the ability to provide a cost-competitive alternative to terrestrial broadband services.

Though Hughes cannot offer at this time a "cure all" solution to the competing interests in the 17.7 - 19.7 GHz band, Hughes has worked with the other satellite interests and terrestrial interests toward the development of a viable alternative for this band. Certain possible alternatives are under consideration, and some of them are dependent on issues that are beyond the control of commercial interests. Hughes is committed to continue working with industry and the Commission to find a mutually acceptable solution based on the premises set out above.

V. GSO FSS BLANKET LICENSING

Hughes applauds the Commission's acknowledgment of the need to develop blanket licensing procedures for broadband satellite networks at Ka band. The broadband Ka band networks that will be implemented will likely employ millions of antennas with ultra small apertures (diameters as small as 66 cm or about 26"). These antennas will be distributed through retail outlets and will be designed to be easily installed by consumers and small businesses. As broadband Ka band systems will be participating in the highly competitive broadband/multimedia market, they would be hampered by any regulations that unnecessarily add to the cost of deploying the terminals and therefore increase the cost to the end user. Thus,

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22 *Id.*

Hughes urges the Commission, in developing blanket licensing regulations, to take into account the cost impact of these regulations on small businesses, consumers and other end users.

Hughes supports the use of the Ku band VSAT model for developing blanket licensing rules for Ka band USATs.[23] The Commission's Ku band blanket licensing policy has facilitated the rapid deployment of large numbers of VSAT networks that serve a wide variety of businesses. Among other things, the Ku band model has allowed Ku band VSATs to be provided at economical prices by minimizing the associated regulatory and administrative overhead costs. Significantly, however, the Ku band rules have not disrupted the flexibility inherent in the inter-operator satellite coordination process that has allowed VSAT networks to coexist in the Ku band along with satellites that provide video distribution to cable systems and direct-to-home satellite service (DTH). In order to support the growth of Ka band satellite services, that same flexibility should be retained here. And any variance from the Ku band blanket licensing approach should be adopted only if the variance is specifically and explicitly identified by the Commission in a manner that allows all parties an opportunity to adequately address the issue.

A. General Approach

At the outset, Hughes is concerned that the Commission not adopt a "one size fits all" approach to earth station licensing at Ka band. In other words, while the development of appropriate USAT licensing parameters is critical for many Ka band satellite businesses, those parameters do not necessarily apply to other Ka band satellite systems. Any attempt to turn the proposed USAT blanket licensing parameters into a *de facto* limit on Ka band spacecraft

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[23] *See* NPRM at ¶ 47.

downlinks in general could preclude the development of non-USAT applications in the Ka band, including the deployment of DTH receive-only antennas that, by definition, are not licensed. Thus, the development of these rules must be done with due consideration of its impact on other users of the band, including DTH uses.[24]

The history of the commercial development of the C and Ku bands demonstrates why the Commission should be extremely careful not to unduly constrain commercial use of the Ka band at this time. Today, the C band is used by satellites primarily for the distribution across the country of video programming to cable headend, DTH and DBS systems. But in the early days of the C band, almost everyone's plans presumed that it would be used primarily for long haul telecommunications, such as long distance telephony. In the ensuing years, a number of things changed: fiber optic capacity became widespread and cheaper, video programming services such as HBO developed, and there developed both the regulatory and technical means to deliver video programming to backyard dishes. None of this could be foreseen in the early 1970s. Thus, had the Commission initially adopted rules that effectively precluded the development of video distribution at C band, the current DTH market may not have developed, and cable television may not have grown as a competitive alternative for delivery of program material.

Similarly, the Commission's decision not to constrain use of the Ku band has allowed that band to be used to support both the burgeoning VSAT market, as well as the PRIMESTAR DTH business in an FSS band. In particular, the Commission has declined to

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24 *See* Comments of DIRECTV Enterprises, Inc. in IB Docket 98-172 (filed November 19, 1998).

impose a "standard" frequency and polarization plan for Ku band spacecraft. Instead, the Commission has left such matters to satellite operators as a matter of coordination with adjacent licensees. Thus, the Ku band payload of GE's GE-2 spacecraft can be used exclusively to provide PRIMESTAR'S DTH service while the Ku band payload of Galaxy VII can be used primarily to serve the VSAT industry.

At the core of this flexibility at Ku band is the continued requirement that Ku band operators coordinate with adjacent spacecraft operators. Among other things, the lack of a standard Ku band frequency and polarization plan has facilitated an ability to deploy transponders in the way that best meet customer needs, whether they are for 27, 36, 54 or 72 MHz transponders. Moreover, as the Ku band is not shared with terrestrial users on a co-primary basis, there has been no reason to impose a PFD downlink power limit on Ku band spacecraft. Rather the power on Ku band spacecraft has steadily grown over time as satellite technology has developed, and these power increases have enabled many benefits: more reliable service, increased capacity, and service to smaller, less expensive antennas. And smaller antennas in turn allow satellite operators to better respond to customer demands for less obtrusive antennas, to reduce installation costs, and to minimize the cost and delay of zoning problems.

Of course, the technical parameters that apply to Ku band VSATs are critical to both the ability to license hundreds of thousands of Ku band on a streamlined basis and the ability of these mass deployed systems to coexist in a two degree spacing environment. But these requirements have never been blindly applied to non-VSAT systems at Ku band. Rather, the Commission has developed a regulatory scheme that both facilitated the VSAT industry and also allowed the development of non-VSAT businesses, such as Ku band DTH. These needs should be taken into account here as well.

In this regard, it is important to recognize that there will be different types of earth stations in the Ka band, as there are at C and Ku band. Some, such as mass-market consumer terminals, will be suitable for blanket licensing. Others, such as video feeder uplinks to DTH systems and SNG truck uplinks, are, by definition, much more sophisticated technically and are more appropriately licensed on an individual basis.

While it appears that the NPRM's blanket licensing parameters are intended to apply only to blanket-licensed USATs, there is some ambiguity about the scope of the Commission's proposal.[25] Hughes urges the Commission to clarify the types of earth stations to which the proposed blanket licensing parameters will apply, and those to which it will not apply and, in doing so, to follow the same general approach that is in place at Ku band.

At Ku band, the Commission's earth station licensing rules regulate separately four different "classes" of earth stations:

- Class 1: Blanket licensing on a routine basis for VSAT networks that comply with certain power limitations. This approach applies to virtually all VSAT terminals that are licensed today.
- Class 2: Blanket licensing on a non-routine basis for VSAT networks that do not comply with the power limitations. This approach is possible, but only rarely used, if at all.
- Class 3: Individual licensing on a routine basis of non-VSAT earth stations that meet certain power limits. This approach applies to almost all large Ku band antennas, such as feeder links to DTH satellite systems and video backhaul applications.

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25 *Cf.* NPRM at ¶ 3 (proposing blanket licensing procedure); NPRM at ¶ 60 (suggesting extension of 25.134(b) to Ka band blanket licensed USATs) *with* NPRM at Appendix C (proposed rule § 25.138 addresses all Ka band earth stations.)

- Class 4: Individual licensing on a non-routine basis of non-VSAT earth stations. This approach applies to large Ku band antennas that do not comply with certain power limits, but are able to demonstrate an ability to operate in a 2° environment.

In addition, there is another "class" of terminals that simply are not licensed at all: the receive-only antennas used for direct-to-home (DTH) video service.

Licensing of Classes 1 and 2 are governed by Part 25.134 of the Commission's rules. The most significant difference is that a Class 2 facility will be licensed only after a sufficient technical demonstration is made, and after the licensee has coordinated with all adjacent Class 1 VSAT systems. In addition, a Class 2 system is effectively "secondary" to any adjacent Class 1 systems that are licensed in the future: the Class 2 licensee bears the burden of coordinating with any such later deployed systems, and must reduce power to accommodate them, as required.

In contrast, Class 3 and Class 4 earth stations are governed by a different set of rules that recognize the needs of other services.[26] In this case, the primary purpose of the rules is to ensure compatibility in a two degree spacing environment. But no matter how technically advanced a Class 3 or Class 4 earth station may be, when it is used for video signals, there is always the possibility, in a two degree environment, that it may create unacceptable interference to a co-frequency, co-polarized VSAT service. In this case, the required coordination with an adjacent satellite is a matter left to the satellite operators. And, in stark contrast to a Class 2 station, a Class 3 or 4 earth station is not required to alter its operations in order to accommodate future adjacent VSAT facilities. Thus, the Commission does not require that a Class 3 or 4 earth

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[26] *See* 47 C.F.R. §§ 25.211, 25.212 (1997).

station, such as a DTH feeder link station, be built in accordance with the lowest common denominator in the VSAT industry.

And, in further contrast are the receive-only DTH terminals used for PRIMESTAR service at Ku band today. Those terminals simply are not regulated. Nor is the power level of the spacecraft used to serve those terminals limited in the same way it is with VSAT networks.[27] Rather, the successful operation of that system is a matter that has been left to inter-system coordination among satellite operators.

In short, Hughes supports the adoption of appropriate rules that are designed to avoid interference among Ka band USAT networks, but Hughes does not believe that the Commission should develop these rules in a manner that would unduly constrain other types of earth stations, or would constrain receive-only terminals, that will be deployed in order to meet other Ka band service needs.

Finally, an important touchstone for the Commission in developing the Ka band blanket licensing rules must be the preservation of flexibility for future developments and innovations in technology. While, blanket licensing is critical to allow the rollout of the first generation Ka band systems, the blanket licensing rules also must support the deployment of future generations of Ka band systems that will take advantage of advances in technology that are not available today.

B. Specific Proposals for USAT Blanket Licensing

At the outset, Hughes notes that, as the Commission is aware, an industry working group composed of the GSO FSS Ka band licensees met regularly over the past year to study the

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27 *Cf.* 47 C.F.R. § 25.134 (1997) *with* 47 C.F.R. § 25.212 (1997).

parameters for the blanket licensing of USATs in the GSO FSS portions of Ka band. The group focused on what Hughes has referred to as "Class 1" or "compliant" USAT terminals and did not focus on the licensing parameters for other types of Ka band earth stations. All of the participants worked in good faith during this process, but the group was unable to reach a consensus on two of the key parameters for the blanket licensing regime of the Class 1 station: the uplink EIRP and downlink pfd figures. As set forth below, Hughes believes that the most appropriate figure for an uplink coordination threshold, under clear sky conditions, is an off-axis (2°) EIRP of +20.0 dBW/MHz in directions within 3° of the GSO arc. For a downlink coordination threshold, Hughes believes that the most appropriate figure is an average pfd on the earth's surface over any contiguous 40 MHz segment of -118 $dbW/m^2/MHz$.[28]

In the case of both the uplink and downlink coordination thresholds, Hughes' position is different than that of the other participants in the industry group. These differences are not the result of engineering calculations. These differences are, instead, driven by Hughes' fundamentally different view of the impact of these values on the cost of providing an economically viable broadband satellite service and Hughes' desire to deploy the most advanced system architecture. The differences between Hughes and many of the other GSO licensees are significant. Utilizing the values supported by the other companies will increase the cost of Ka band user terminals, reduce service availability and generally place satellite services at a competitive disadvantage to terrestrial competitors, thereby reducing choices and increasing prices for consumers.

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28 Hughes was unable to join in the Report of that group for the reasons set forth in Hughes' separate statement to that Report and the other reasons set forth below.

With regard to the uplink power coordination threshold for Class 1 stations, a majority of the participants in the working group -- in fact all but Hughes and PanAmSat -- have indicated that they would be willing to settle for an off-axis (2°) EIRP figure of +25.0 dBW/MHz. Hughes believes that the adoption of this figure by the Commission would significantly impair the competitiveness of Ka band satellite systems vis-à-vis terrestrial broadband providers. Hughes intends to provide a wide range of broadband communications services to its target consumer and small business markets. Yet, competitive implementation of these services depends on the deployment of a very large number of small, inexpensive, user-installable satellite terminals. The key driver of the cost of a USAT earth station is the size of the amplifier, which is in turn driven by the power that the earth station needs to deliver to the satellite.

Using current satellite and earth station technology, it is possible to design a system that achieves a significantly lower off-axis EIRP than the 27.5 dBW/MHz proposed by the Commission in the NPRM and still provide a level of high-quality service that is competitive with terrestrial alternatives. With current antenna technology, Hughes believes that it is possible today to achieve a level of 20.0 dBW/MHz. Requiring this level of off-axis EIRP would produce significant public interest benefits.

As set forth in Appendix B, by reducing the level of potentially interfering emissions into adjacent systems, a lower EIRP threshold provides the opportunity for all systems to benefit from operations at generally lower transmit power levels. This means that earth terminals do not need to radiate as much power and therefore can be manufactured at a lower cost. Thus, in turn, the cost of service to the end user can be lower and satellite services can be made even more competitive with terrestrial alternatives. In addition, a lower EIRP threshold provides the opportunity to exploit future advances in antenna technology on the satellite in order to either further reduce terminal power and costs or to provide an even more reliable level of service.

With regard to the downlink power coordination threshold for Class 1 stations, a majority of the participants in the working group -- in fact all but Hughes and PanAmSat -- have indicated that they would be willing to settle for an average pfd on the earth's surface over any contiguous 40 MHz segment of -120 $dbW/m^2/MHz$. Hughes believes this power level will not allow satellite services to be provided at a sufficiently high level of availability. To provide state of the art broadband service to the public, Hughes advocates a USAT downlink power coordination threshold of an average pfd on the earth's surface over any contiguous 40 MHz segment of -118 $dbW/m^2/MHz$.[29]

Finally, while Hughes recognizes the importance of blanket licensing for all satellite systems, there are different considerations that may affect the ease and speed with which appropriate blanket licensing criteria can be developed in different parts of the Ka band. Hughes urges the Commission not to delay the resolution of blanket licensing in one part of the band pending the resolution of unrelated issues in another part. Clearly, the "easiest" parts of the band to address are the 19.7 - 20.2 and the 29.5 - 30.0 GHz bands, where the GSO FSS is primary and there are no terrestrial allocations. Bands that are currently shared between FSS and terrestrial fixed service are more difficult to address because the Commission must first develop a band segmentation plan. Moreover, as noted below, blanket licensing in the NGSO FSS bands, 18.8 -

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29 See Technical Appendix B.

19.3 and 28.6 - 29.1 GHz, must take into account the inevitability that multiple systems will be serving these bands on a co-frequency basis. Given the factors that may delay resolution of blanket licensing in other parts of the band, there is no reason to delay resolution of blanket licensing terms for the 19.7 - 20.2 and 29.5 - 30.0 GHz bands.

VI. NGSO BLANKET LICENSING

As a second-round applicant for an NGSO FSS system,[30] Hughes agrees with the Commission that blanket licensing in the NGSO FSS bands is clearly a critical and necessary step for deployment of those systems and should be addressed at the earliest possible date. However, the Commission is also right to note that the technical criteria ultimately adopted to facilitate blanket licensing of NGSO/FSS earth stations "must permit multiple NGSO/FSS systems to share the band."[31]

At this point in time, the sharing criteria necessary to permit multiple NGSO FSS systems to share the same frequency band simply have not been developed. And as the Commission noted in the NPRM, these satellite sharing criteria must be consonant with the criteria adopted for blanket licensing NGSO earth stations. Therefore, neither the industry nor the Commission has sufficient information at this time to allow the Commission to adopt a set of blanket licensing parameters. Some additional, possibly informal, process will be required to try to develop appropriate blanket licensing parameters, along with appropriate space segment sharing parameters, for the NGSO FSS systems that will use the 18.8 - 19.3 GHz band before

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30 *See* Application of Hughes Communications, Inc. for Spaceway NGSO, 44-SAT-:/LA-98(20) (filed December 22, 1997).

31 NPRM at ¶ 69.

these matters will be ready for rulemaking. Any blanket licensing solution must also be compatible with the ultimate requirements for effective NGSO/NGSO system sharing.

VII. THE COMMISSION'S SECONDARY LICENSING PROPOSAL

In the Notice of Proposed Rulemaking, the Commission indicated that any terrestrial systems applied for in the 17.7 - 19.7 GHz band between September 18, 1998 and the release of a report and order in this proceeding would be subject to the outcome of this proceeding.[32] That is, any post-NPRM terrestrial license that was applied for and granted after the release of the NPRM with respect to a band that is *ultimately* designated for primary FSS use, will be secondary to that primary FSS use. The Commission justifiably could have frozen the acceptance and processing of all applications in the 18 GHz band, but it has not yet done so. The Commission's action appropriately recognizes the problems and inequities that could develop absent some restriction on the ability of the terrestrial fixed service to continue to deploy systems in the 17.7 - 19.7 GHz band pending the resolution of the NPRM. As the Commission has recognized in a number of other analogous circumstances, continued licensing in a band that is the subject of a segmentation proposal can prevent a rational transition to the Commission's ultimate, modified band plan.[33]

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[32] NPRM at ¶ 40. The Commission's NPRM states that "new terrestrial fixed service applications could continue to be filed and granted after the NPRM release date, but the licensees would only have secondary status in those bands designated for fixed satellite service use on a primary basis." *Id.* The Commission cited the 18.3 - 18.55 GHz and 18.8 - 19.3 GHz bands merely as an "example" of how this scheme would work if the Commission's segmentation proposal in the NPRM *ultimately* were adopted. If it is to work, the Commission's approach must be applicable to any part of the 18 GHz band that ultimately is designated for the FSS on a primary basis. Otherwise, the proposal would not be effective if the Commission should alter its band plan proposal.

[33] *See, e.g.*, *Freeze on the Filing of Applications for New Licenses, Amendments, and Modifications in the 18.8-19.3 GHz Frequency Band*, 11 FCC Rcd 22363 (1996)

Hughes therefore agrees with the Commission that limits on terrestrial licensing in the 17.7 - 19.7 GHz band are necessary during the pendancy of this proceeding. Given the possibility that the FSS will be ultimately assigned to a different portion of the band than is currently proposed in the NPRM, the Commission's secondary licensing approach, to be effective, must necessarily apply to any part of the 17.7 - 19.7 GHz band that is ultimately designated for the FSS on a primary basis. Indeed, the Commission rationally could have, and perhaps should have, instituted a full freeze on acceptance and processing of all applications for terrestrial and earth station licenses in the 17.7 - 19.7 GHz band.

VIII. CONCLUSION

Hughes supports the need for band segmentation between satellite and terrestrial users and the development of blanket earth station licensing criteria at Ka band. In pursuing these two main objectives, Commission should be guided by three core principles: (i) facilitate the prompt deployment of satellite-based alternatives to terrestrial broadband systems; (ii) encourage the use of advanced satellite technology that maximizes service capabilities and minimizes cost to consumers; and (iii) provide for the development of even more advanced satellite technologies in the future.

In this regard, it is critical that the Commission provide for the need of the GSO FSS industry for access to a full 1000 MHz of downlink spectrum for use by ubiquitous earth stations. GSO FSS systems can provide a low cost alternative to terrestrial broadband systems

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(DEMS); *Amendment of the Commission's Rules Regarding the 37.0-38.6 GHz and 38.6-40 GHz Bands*, 11 FCC Rcd 1156 (1995) (39 GHz); *Amendment of the Commission's Rules Regarding the 37.0-38.6 GHz and 38.6-40 GHz Bands,* 12 FCC Rcd 2910, ¶15 (1997) ("Unless we take this approach, we run the risk of undermining our efforts to optimize the public interest.") (same); *See, e.g.*, *Greater Utica-Rome TV Services, Inc.*, 7 FCC Rcd 2252, ¶2 (1992) (digital television).

only if the GSO FSS is provided sufficient bandwidth. Thus, the Commission should modify its band plan and reaffirm its commitment to the development of Ka band satellite services.

Finally, in developing appropriate criteria for services that will be blanket licensed, the Commission should ensure that those regulations do not unduly constrain the development of new services in the band. And while blanket licensing is critical to allow the rollout of the first generation Ka band systems, the relevant rules also must support the deployment of technology that is not available today.

Respectfully submitted,

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TECHNICAL EXHIBIT A

TECHNICAL APPENDIX A: GSO FSS / NGSO MSS FEEDER LINK SHARING PRINCIPLES IN THE 29.25-29.5 GHZ BAND

Spectrum sharing between a GSO FSS system with ubiquitous small terminals and NGSO MSS feeder links in the 29.25-29.5 GHz band can successfully occur if two simple rules are followed. These rules are consistent with ones already adopted by the FCC in Part 25.258 of the Commission's rules[1]. The first rule is that GSO FSS uplink beams in the same and adjacent cells as the MSS feeder link must be of different type than the MSS feeder link's beams, where a beam type is associated with a specified frequency band and polarization.

Figures 1 and 2 illustrate how sharing can be accomplished between the SPACEWAY GSO FSS and NGSO MSS feeder links. Figure 1 shows an illustrative 1° satellite beam pattern that covers the contiguous U.S. Figure 2 shows this same beam pattern enlarged and shows how, with appropriate frequency and polarization management, two MSS feeder link sites can safely share spectrum with ubiquitous GSO FSS uplinks. The actual GSO FSS satellite beam pattern may vary from this figure, but will employ the sharing principles illustrated.

Using this frequency and polarization reuse pattern, it is possible to design an MSS system to use the 29.25-29.5 GHz band for feeder links without experiencing harmful interference from ubiquitous terminals of GSO FSS networks. This is shown in the attached link budget in Table 1, "UPLINK Interference to MEO space station." The MSS feeder link C/I ratio with inclusion of SPACEWAY ubiquitous terminal uplink interference is over 50 dB, assuming cross-polarization isolation of 30 dB.

Another rule, requiring the NGSO satellites to have repeating ground tracks, will be helpful in two ways. The first is that, even when an NGSO MSS feeder link earth station is collocated and operates in the same frequency band and polarization as a GSO FSS earth station, harmful interference between the MSS feeder link and the GSO

[1] It is significant that the efficacy of these sharing principles is unaffected by the number of GSO FSS earth stations deployed at 29.25-29.5 GHz, and that these principles apply to GSO FSS earth station antennas 66 cm and larger. The sharing example of the attached link budget assumes an unlimited number of GSO FSS earth stations with 66 cm antennas.

network can be avoided by carefully choosing the Right Ascensions of the Ascending Node (RAANs)[2] of the NGSO satellites. The RAANs must be chosen such that the NGSO satellites maintain enough angular separation from the GSO satellite in question so as to prevent harmful interference between the NGSO and GSO systems. The RAAN can only be chosen for a repeating ground track because with a non-repeating ground track the RAAN changes significantly over time. An NGSO with a non-repeating ground track will maintain its initially chosen RAAN only for a short time. Figures 3 through 8 show how interference is mitigated with proper selection of the RAANs for a 3 plane, repeating ground track NGSO satellite system with circular orbits of altitude 10355 km and inclination 50°. Figures 3 through 5 show the azimuth and elevation angles from an East Coast site to the NGSO satellites and to a GSO satellite located at 101° W. The orbit plane of Figure 3 has a RAAN of 95°, that of Figure 4 has a RAAN of 215°, and that of Figure 5 has a RAAN of 335°. These figures show that the difference in angles pointing to the NGSO satellite and the GSO satellite is always at least about 8°. This angular separation provides at least 30 dB of interfering signal attenuation by an interfering earth station antenna.

Figures 6 through 8 show the same mitigation technique with the same RAANs for a West Coast site. These figures show that the difference in angles pointing to the NGSO satellite and the GSO satellite is always at least about 15°. Again, at least 30 dB of interfering signal attenuation will be provided by an interfering earth station antenna because of this large angular separation.

The second benefit from repeating ground tracks is that, interference from an NGSO system with a repeating ground track is easily tracked back to the specific NGSO feeder link interferor, and then the specific link can be dealt with. If the NGSO satellite does not have a repeating ground track, it will be difficult to ascribe interference to a specific link, as the NGSO satellite orbital history will be complex.

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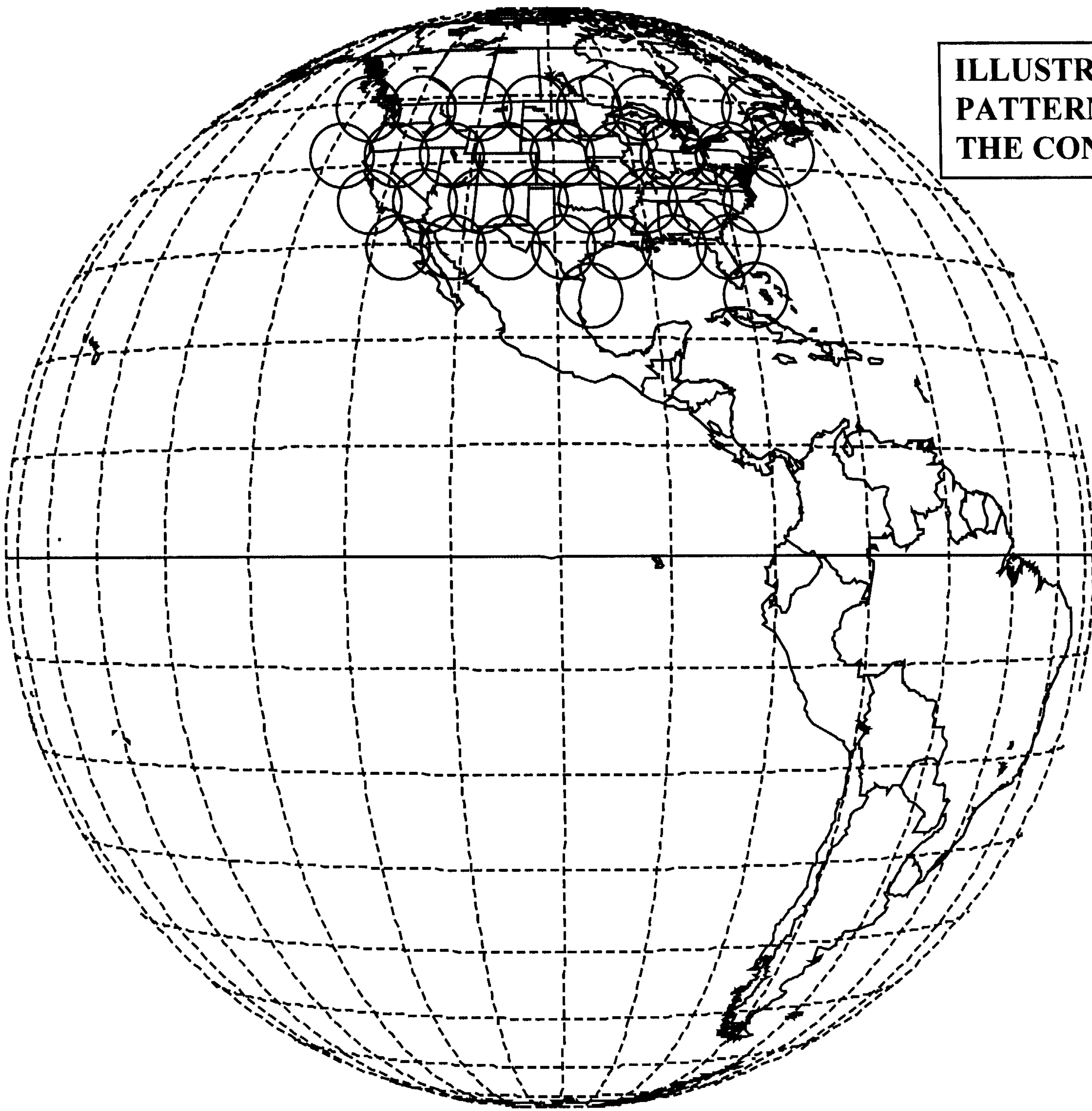
[2] The RAAN specifies where the orbit crosses the Earth's equatorial plane as it flies Earth-Northward. For a satellite with a circular orbit of given altitude and inclination, the RAAN determines the look angles to the satellite from an earth station.

The current FCC rules support two major sharing techniques between NGSO MSS feeder links and GSO FSS systems with small ubiquitous terminals. Either technique, frequency and polarization management or careful choice of RAANs for repeating ground track NGSO MSS systems is adequate to allow sharing of spectrum between the NGSO system and a GSO system. These techniques can also be combined to allow sharing without harmful interference in the case where the full mitigation of one of the techniques is not achieved because its rules are not strictly followed.

UPLINK Interference to MEO space station		Comments
EIRP of interferor, dBW	39.3	S/WAY filing, Hi-pwr narrow spots
Bandwidth mismatch factor, dB, single user@ MEO	-7.0	0.1MHzMEOg/way,0.5MHz S/WAY
MEO Spc. Sta. Anten. gain towards interferor, dBi	8.4	assumes adj. cell with xpol. discrim.
Fr.Spc. loss @29.5GHz: (4 pi slant_range / λ)^2, dB	-203.9	note elevation angle below
Atmospheric loss for this path, dB	-1.0	Clear sky, approx. for 25 deg elev.
Implementation loss (pointing, polarization), dB	-3.5	Typical NGSO
Altitude of circular orbit, m	10355000	MEO apogee
Elev. angle from interferor to MEO spc. sta., deg	30.0	
Slant range from interferor to MEO spc. sta., m	12606067	
Interferor power received by MEO spc. sta., dBW	-167.6	
Single (1 user)carrier EIRP of desired signal, dBW	54.2	Typical MEO MSS feeder link
MEO Spc. Sta. Ant. gain towards desired signal,dBi	38.4	Typical MEO MSS feeder link
Fr.Spc. loss @29.5GHz: (4 pi slant_range / λ)^2, dB	-205.0	note elevation angle below
Atmosperic loss for this path, dB	-1.0	Clear sky, approx. for 25 deg elev.
Implementation loss (pointing, polarization), dB	-3.5	Typical NGSO
Altitude of circular orbit, m	10355000	MEO apogee
Elev. angle from MEO E/sta. to MEO S/station, deg	10.0	
Slant range from MEO E/sta. to MEO S/station, m	14401857	
Desired power received by MEO space station, dBW	-116.9	
C/I, dB	50.7	

This analysis is not to be construed to be comprehensive and inclusive of all potential sharing scenarios, but it is illustrative of potential sharing solutions.



ILLUSTRATIVE 1° BEAM PATTERN COVERAGE OF THE CONTIGUOUS U.S.

FIGURE 1

ILLUSTRATIVE SPACEWAY & MSS MEO FEEDER LINK SHARING PLAN FOR CONTIGUOUS U.S., 29.250 - 29.500 GHz

Beam Type 1 = RHC Polarization, 29.250-29.375 GHz
Beam Type 2 = RHC Polarization, 29.375-29.500 GHz
Beam Type 3 = LHC Polarization, 29.250-29.375 GHz
Beam Type 4 = LHC Polarization, 29.375-29.500 GHz
Beam Type X = No SPACEWAY beam in the 29.250-29.500 GHz band (beam(s) using other band(s) will be utilized.)

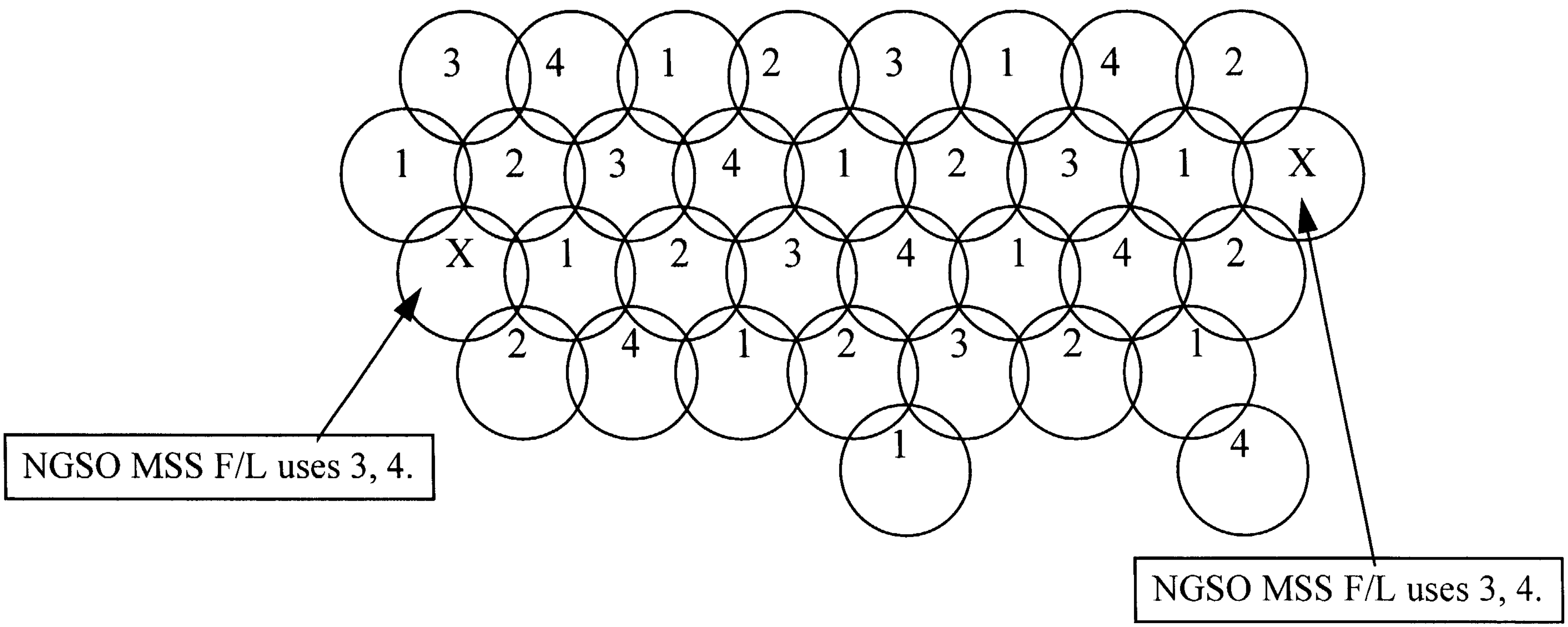


FIGURE 2

Azimuth & Elevation for MEO in Plane 1c (RAAN=95 deg) viewed from (43 N, 70 W)

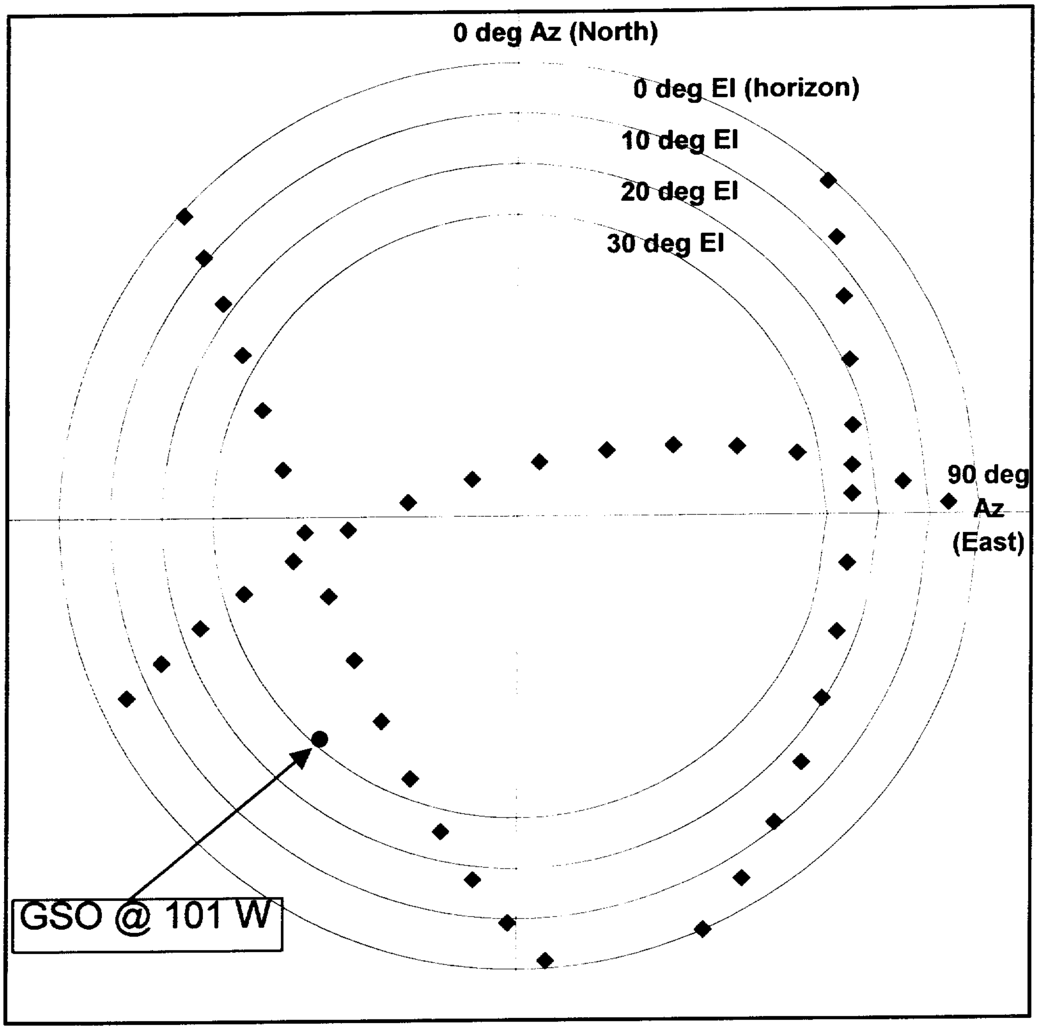


FIGURE 3

Azimuth & Elevation for MEO in Plane 2c (RAAN=215 deg) viewed from (43 N, 70 W)

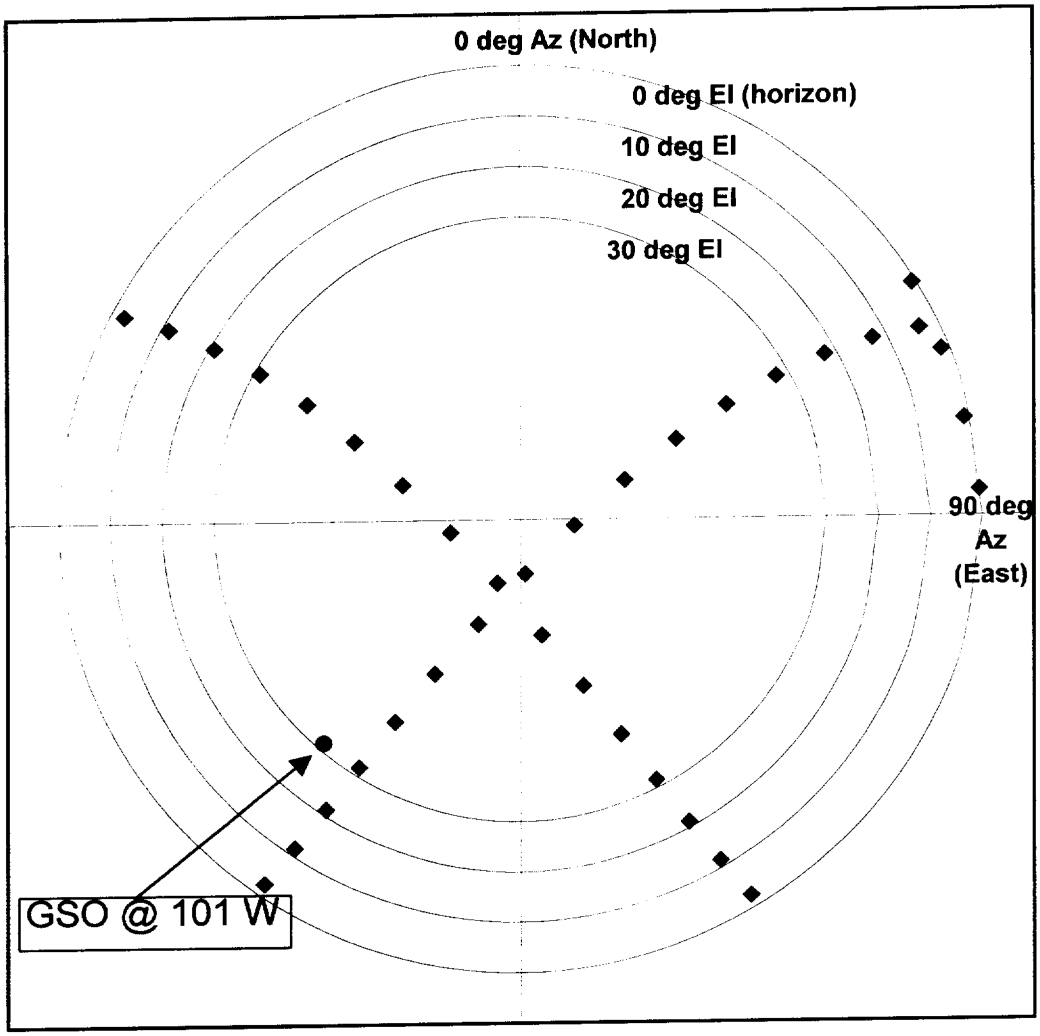


FIGURE 4

Azimuth & Elevation for MEO in Plane 3c (RAAN=335 deg) viewed from (43 N, 70 W)

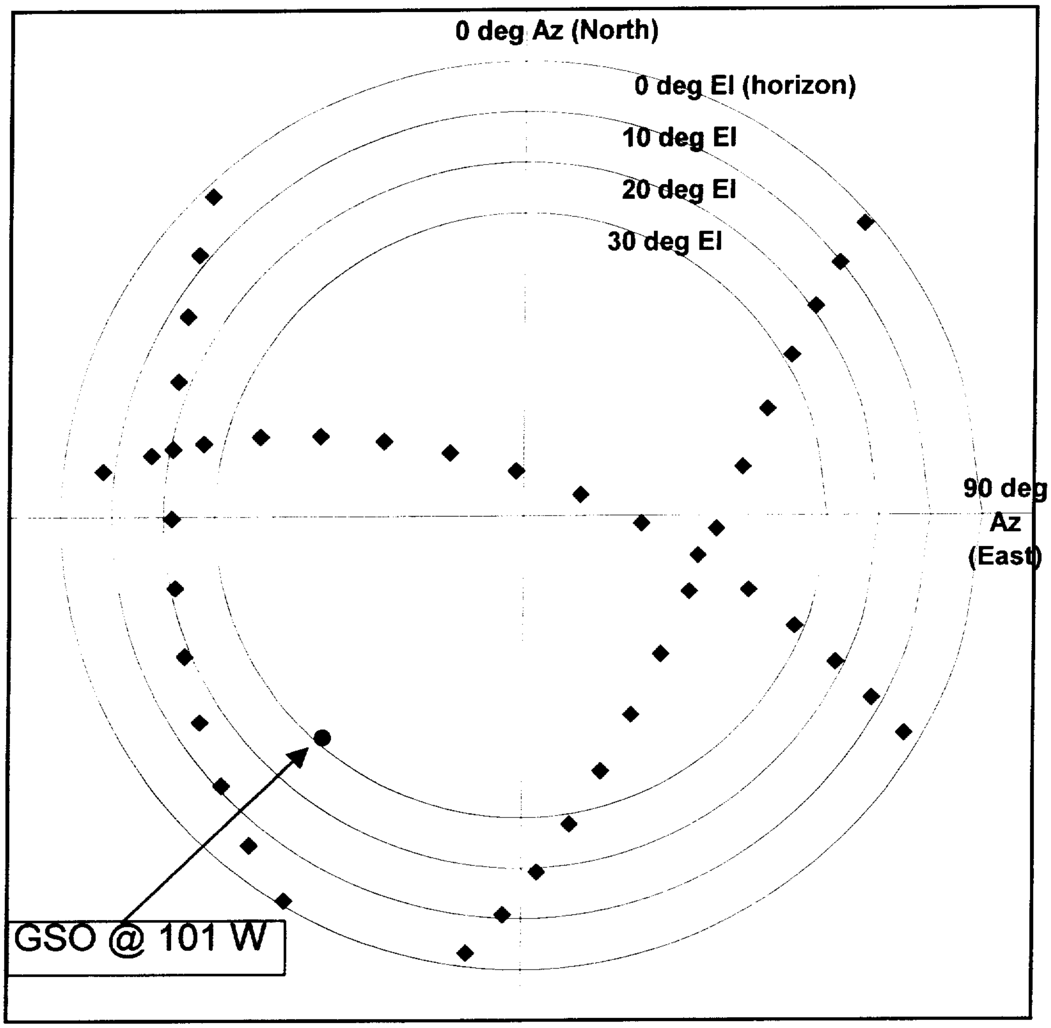


FIGURE 5

Azimuth & Elevation for MEO in Plane 1c (RAAN=95 deg) viewed from (35 N, 121 W)

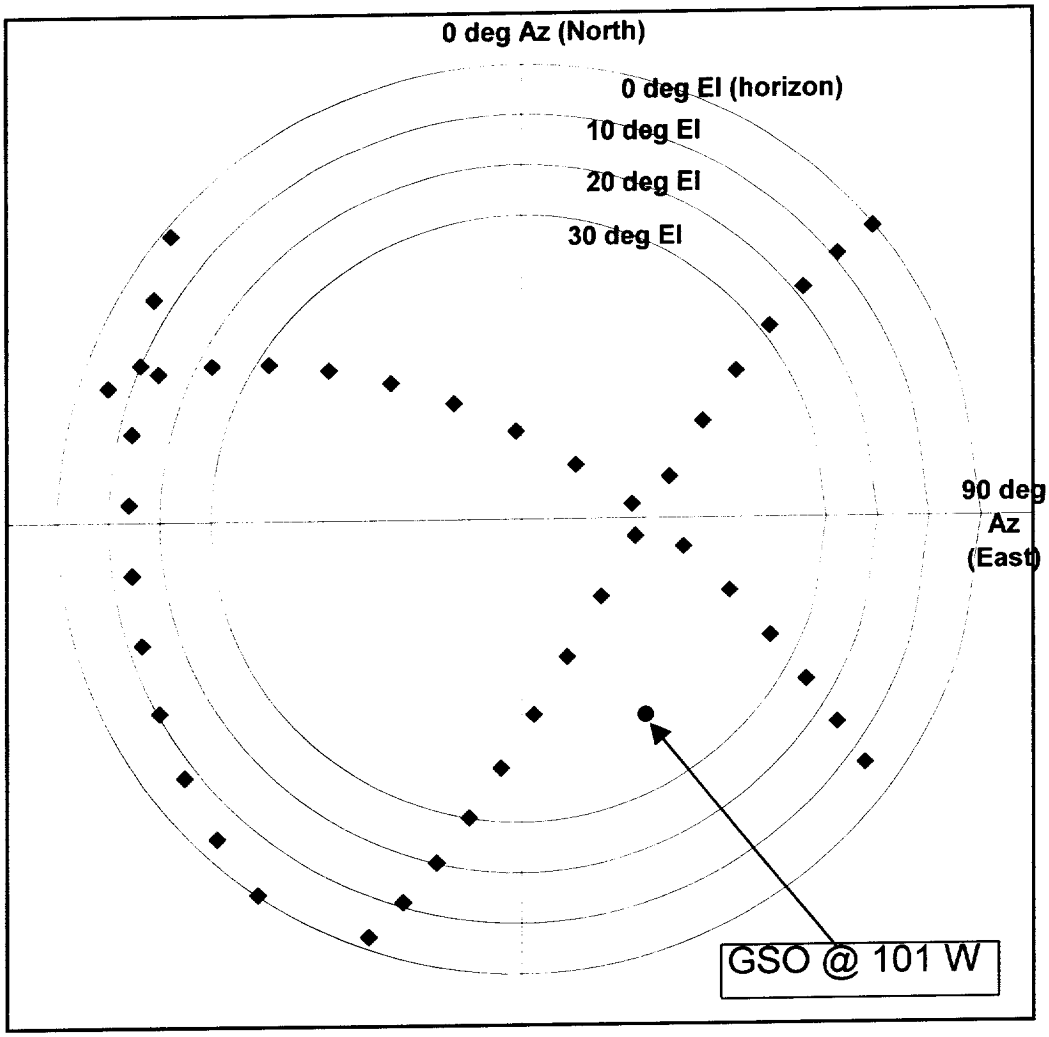


FIGURE 6

Azimuth & Elevation for MEO in Plane 2c (RAAN=215 deg) viewed from (35 N, 121 W)

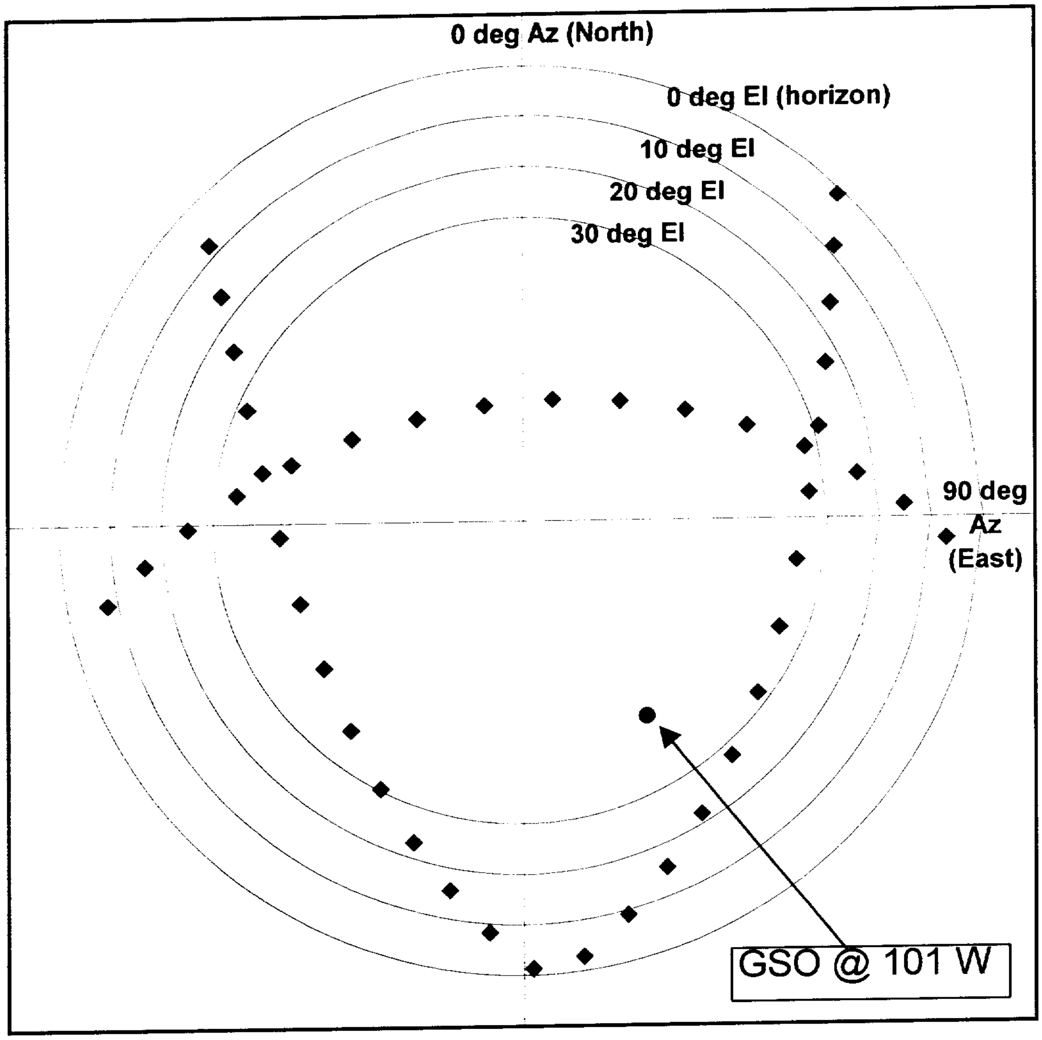


FIGURE 7

Azimuth & Elevation for MEO in Plane 3c (RAAN=335 deg) viewed from (35 N, 121 W)

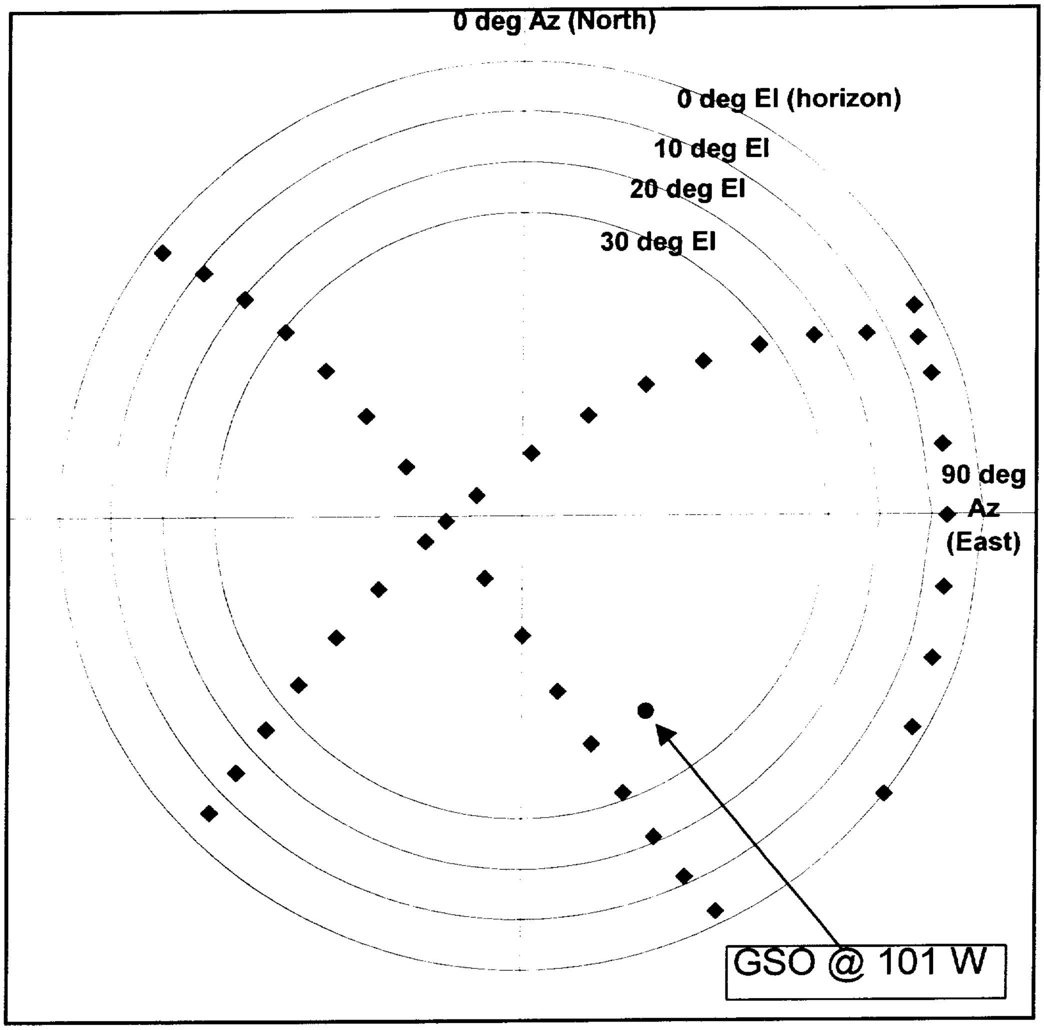


FIGURE 8

Engineering Certification

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in Appendix A, that I am familiar with Part 25 of the Commission's Rules, that I have either prepared or reviewed the engineering information submitted in Appendix A, and that it is complete and accurate to the best of my knowledge.

By: H. Chew

Hubert Chew, Project Engineer
Regulatory Affairs & Spectrum Management
Hughes Communications, Inc.

November 19, 1998

TECHNICAL EXHIBIT B

TECHNICAL APPENDIX B

Ka-BAND BLANKET LICENSING PROPOSAL

I. INTRODUCTION

The purpose of blanket licensing is to create a regulatory mechanism that permits Ka-Band GSO FSS licensees to deploy large numbers of small earth stations without the need for individual earth station licenses and to operate their networks without causing or receiving unacceptable interference from other licensed systems which operate large numbers of small earth stations on a co-frequency, co-coverage basis.

II. Ku-BAND VSAT NETWORKS BLANKET LICENSING PARAMETERS

Currently, a large number of Very Small Aperture Terminal ("VSAT") networks operate in the 12/14 GHz frequency band (Ku-Band) under blanket licenses granted by the Commission. As part of the blanket licensing rules, the Commission adopted appropriate up-link and down-link power densities and antenna performance standards that would allow VSATs to operate in a minimal interference environment. Key blanket licensing parameters are as follows: maximum outbound down-link EIRP density of +6.0 dBW/4 KHz per carrier, maximum input power density to the antenna at –14 dBW/4 KHz, and maximum hub EIRP of 78.3 dBW. Additionally, VSAT antennas are required to conform to Part 25.209 of the Commission's rules. Licenses are granted for ten years, and construction periods are ten years and one year for VSATs and hub, respectively.

III. Ka BAND BLANKET LICENSING PROPOSAL

Because Ka-Band GSO FSS operators will potentially deploy hundreds of thousands of small terminals, Hughes, as a licensee, supports blanket licensing in any part of the Ka-band designated for the GSO FSS. The following sections address the various issues identified in the FCC NPRM.

(a) Up-link Off-Axis EIRP Density

In the GSO Blanket Licensing Industry Working Group, Hughes had been advocating a higher EIRP density value, about 28 dBW/MHz, primarily to protect the desire to use FM-TV SNG up-links in Ka-band. After having critically reviewed our business plans and system designs, Hughes believes the number of Ultra Small Aperture Terminals (USATs) at Ka-band will be far greater, by several orders of magnitude, than the number of FM-TV SNG terminals. Because FM-TV SNG EIRP operational level is higher than typical USAT EIRP operational level, those FM-TV SNGs will cause unacceptable interference into USATs unless we establish an appropriately low coordination threshold. As a result, for blanket licensing purposes, Hughes believes the coordination threshold should be set to protect the USAT application, while the FM-TV SNG application may have to operate under an individual routine license.

An off-axis up-link EIRP density of 20 dBW/MHz will benefit all GSO applicants.

An up-link EIRP density at 2° off-axis of 20 dBW/MHz provides more benefits to all GSO applicants than an up-link EIRP density of 27.5 dBW/MHz. One benefit is that because the interference level will be lower with an adjacent satellite system's EIRP density of 20 dBW/MHz as compared to a density of 27.5 dBW/MHz, the link in question will have a higher overall link margin given that the up-link power from the terminal is the same for both density cases. That margin can be exploited in either of two ways. One way is for the earth station operator to keep the higher link margin, i.e., he does not have to lower the up-link power, in order to benefit from a higher link availability. Another way is for the operator to reduce the link margin by lowering his up-link power in order to obtain a normal link availability. A lower up-link power leads to a smaller terminal, which in turn equates to a lower cost terminal.

It is typically a trend in satellite technology that future satellite systems will successively be constructed with higher sensitivity, i.e., higher satellite G/T. Thus future terminals can transmit lower power than present terminals in order to close a link with future satellites at the same level of link availability. If the interference level is low, as is the case with 20 dBW/MHz, the benefit of a more sensitive satellite can be fully realized. If the interference level is high, as is the case with 27.5 dBW/MHz, future terminals will have to maintain the same up-link power to ensure an acceptable link availability even though future satellites are more sensitive. Thus by having more sensitive satellite and a low interference environment, a higher link margin will result. Then logic will lead to the same conclusion: higher margin can either mean higher availability or lower cost terminal.

The potential reduction in terminal EIRP (or power) resulting from a lower adjacent satellite's EIRP density value can be determined from technical parameters directly obtained from various Ka-band GSO FSS applications. Those parameters, shown in Table 1, are edge of beam satellite G/T, edge of beam thermal C/N, and internal C/I. Table 1 also shows computed EIRP densities at 2° off-axis, which are simply summations of HPA power densities and 21.5 dBi, the antenna gain at 2° off-axis in accordance with the antenna sidelobe performance of $29 - 25\log(\varphi)$.

Table 1. Ka-band GSO FSS Clear Weather Operating Parameters

System	Satellite EOB G/T (dB/K)	Thermal C/N (dB)	Internal C/I (dB)	EIRP Density at 2° Off-Axis (dB(W/MHz))
Spaceway	13.9	11.7	14.7	20.0
Panamsat	14.0	12.0	15.0	20.0
GE	14.5	9.9	15.3	17.6
Astrolink I	12.2	7.3	13.4	16.6
Astrolink II	12.8	18.9	14.1	28.0
Loral	8.4	9.8	17.4	24.0
Orion	12.4	11.6	20.9	22.8
KaStar	14.0	8.3	17.4	26.7
Motorola	12.2	13.3	N/A	24.0

It is possible to calculate the terminal on-axis clear air EIRP for each system from the above parameters. In order to perform the above on-axis EIRP calculations, 215 dB is assumed for the total clear-air path loss, which includes 1.4 dB of atmospheric losses.

Table 2 shows terminal on-axis EIRP values for three different cases for a given C/(N+I). The first case provides on-axis EIRP based on adjacent satellite systems' off-axis EIRP density values from Table 1. The second case provides on-axis EIRP for a terminal operating in an environment where the adjacent satellite systems' off-axis EIRP density is 27.5 dBW/MHz. The third case provides on-axis EIRP for a terminal operating in an environment where the adjacent satellite systems' off-axis EIRP density is 20 dBW/MHz. Two external interferers are assumed for all systems. Finally, Table 2 lists the potential reduction in terminal on-axis EIRP for each system when the adjacent satellite interference environment drops from 27.5 dBW/MHz to 20 dBW/MHz. For example, Hughes Spaceway would be able to reduce its terminal EIRP by 4.1 dB, and PanAmSat by 3.8 dB. Even the smallest reduction in terminal EIRP is still about 1.5 dB (Motorola). In short, the reduction in terminal EIRP equates directly to a reduction in terminal cost.

Table 2. On-Axis EIRP Reduction for a Change in Adjacent Satellite Systems' Off-Axis EIRP Density from 27.5 dBW/MHz to 20 dBW/MHz

System	Table 1 Value (dB(W/MHz))	27.5 (dB(W/MHz))	20 (dB(W/MHz))	EIRP Reduction (dB) (27.5 and 20 Off-Axis EIRP Density)
Spaceway	44.3	48.4	44.3	4.1
Panamsat	44.5	48.3	44.5	3.8
GE	41.9	44.4	42.2	2.2
Astrolink I	41.6	43.3	41.8	2.5
Astrolink II	50.9	50.6	48.9	1.7
Loral	47.9	49.4	47	2.4
Orion	45.7	46.9	45.3	1.6
Ka-Star	40.8	41.2	39.1	2.1
Motorola	47.6	48.5	47	1.5

The reduction from 27.5 dBW/MHz to 20 dBW/MHz reduces the required on-axis EIRP for all systems from 1.5 minimum to as much as 4.1 dB.

The Hughes link design is based upon an off-axis EIRP density limit of 20 dBW/MHz. The resultant EIRP maximum required to meet up-link availability objectives results in a low-cost combination of minimum size antenna and RF power into the antenna. Increasing the off-axis EIRP density limit by 7.5 dB either decreases the fade margin by 4.1 dB, which results in severely degraded availability, or requires an increase in RF power of 4.1 dB, which increases the cost significantly. Either method is detrimental to achieving the business objectives of providing low cost, small terminals to small businesses and consumers.

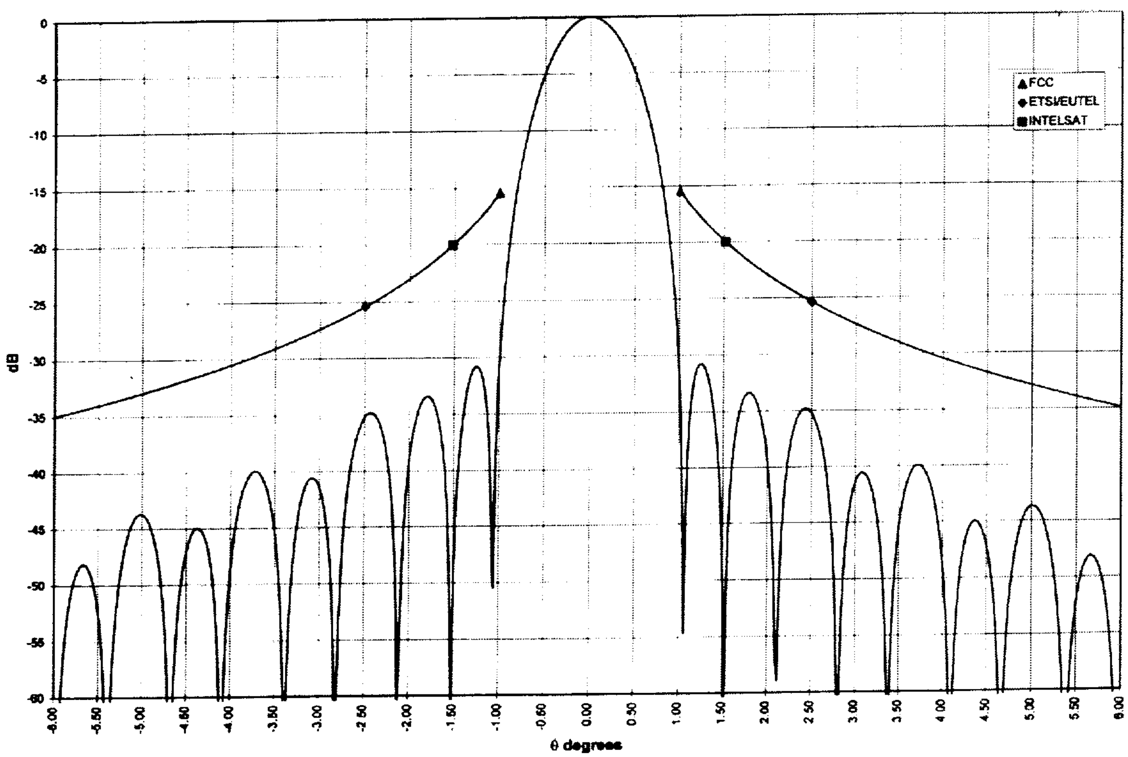
Achieving 20 dBW/MHz is within present day low cost antenna technology capabilities without requiring changes to wanted signal operating values.

Derived from Table 2, Table 3 lists the required off-axis EIRP density discrimination for each system for off-axis EIRP density values of 20 and 27.5 dBW/MHz. While the discrimination required to achieve 20 dBW/MHz off-axis EIRP density is greater than that required for 27.5 dBW/MHz EIRP density, the absolute value is within the capabilities of low-cost antennas as small as 66 cm. Figure 1 is a calculated plot of the off-axis discrimination for an elliptical antenna with the equivalent area of a 66 cm circular antenna operating at 30 GHz. The discrimination is 35 dB at 2 degrees. It should be possible to achieve at least 30 dB of discrimination in an actual antenna, making allowances for actual construction degradations. All of the system discrimination requirements (Table 3) have substantial margin relative to the calculated discrimination. Some systems plan to use larger antennas whose discrimination should be at least this good.

Table 3. Required Off-Axis EIRP Density Discrimination (dB)

System	Discrimination at 20 dB(W/MHz)	Discrimination at 27.5 dB(W/MHz)
Spaceway	24.3	20.9
Panamsat	24.5	20.8
GE	22.2	16.9
Astrolink I	23.3	17.4
Astrolink II	28.9	23.1
Loral	27.0	21.9
Orion	25.3	19.4
Ka-Star	19.1	13.7
Motorola	27.0	21.0

Figure 1. Example Calculated Antenna Discrimination at 30 GHz, 66 cm Equivalent Aperture.



Conclusions

Adopting the off-axis EIRP density mask proposed by Spaceway will benefit Ka-band GSO systems by increasing up-link availability for a given maximum faded EIRP or result in lower maximum EIRP for a given availability. The latter case should result in reduced costs, a critical factor in achieving Spaceway's business goals.

Achieving the proposed mask values is within the capabilities of low cost antenna side-lobe control technology without requiring changes to any licensed system's on-axis operating parameters.

Some of the applicants plan to use transmissions that are less than 1 MHz in occupied bandwidth. The victim spacecraft may therefore see more than one transmission in 1 MHz originating from different earth terminals. Therefore it is proposed that under clear sky conditions, the off-axis EIRP density composite mask in the plane of the geostationary orbit be modified to take into this possibility as follows:

$27.5 - 25\log10(\theta) + A$	dBW/MHz	$2^0 \leq= \theta \leq 7^0$
$6.4 + A$	dBW/MHz	$7^0 < \theta < 9.2^0$
$30.5 - 25\log10(\theta) + A$	dBW/MHz	$9.2° < \theta \leq 48^0$
$-11.5 + A$	dBW/MHz	$48° < \theta \leq 180^0$

A = 0, Bo > 1
A = 10log(Bo), Bo <= 1

Where Bo is the occupied bandwidth of the carrier in MHz

In all other directions the more relaxed EIRP density mask under clear sky conditions should be:

$30.5 - 25\log10(\theta) + A$	dBW/MHz	$2° \leq \theta \leq 48°$
$-11.5 + A$	dBW/MHz	$48° < \theta \leq 180°$

(b) Power Flux Density

Satellite technology now allows quality of service offered by Ka band systems employing small user terminals (66 cm) to be comparable to that offered by Ku-band VSAT systems. This quality of service can be achieved by a power flux density value of -118 dBW/m^2/MHz with little impact on the C/I value of the link. To demonstrate this point Table 4 presents receiver thermal noise increase for PFD values of –118 and –120 dBW/m^2/MHz. Since the link is weakest during rain, a total atmospheric loss of 8.2 dB is considered. It is also assumed that two interferers are present. Table 4 provides the results for antenna off-axis discrimination values of 22 to 25 dB. For this range of discrimination values, receiver noise degradation does not exceed 0.5 dB. Thermal noise degradation due to the additional 2 dB PFD from interfering satellites is only 0.18 dB or less.

The benefit of the higher PFD value (-118 versus –120 dBW/m^2/MHz) is illustrated in Figure 2 where down-link availability values as a function of link margin are shown. The terminal is assumed to be operating in Crane rain zone D2. A 2-dB increase in PFD level can improve down-link availability substantially. For example, a link operating at 99.5% availability level will experience 0.25% improvement in its up time. This improvement translates to about one day per year of increased operational time.

Conclusion

Trends in satellite technology indicate that future Ka-band satellites will be able to output higher EIRP values than previously possible. A PFD coordination threshold of –120 dBW/m^2/MHz will prevent users from taking advantage of improvements made in technology to enhance link quality of service. A higher PFD coordination threshold of –118 dBW/m^2/MHz will provide room for technology improvements without excessively taxing the C/I performance of a potential system.

Unit	Antenna Discrimination	Thermal Noise Increase PFD = -118 dBW/m²/MHz	Thermal Noise Increase PFD = -120 dB dBW/m²/MHz	Δ
dB	22	0.5	0.32	0.18
dB	23	0.45	0.26	0.14
dB	24	0.32	0.21	0.12
dB	25	0.26	0.17	0.09

Table 4. Terminal thermal noise increase (ΔT/T) as a function of antenna discrimination at 2° off-axis for received power flux densities of –118 and –120 dBW/m²/MHz. Terminal G/T in rain is assumed 15 dB. A rain loss of 7.1 dB and atmospheric loss of 1.1 dB are included.

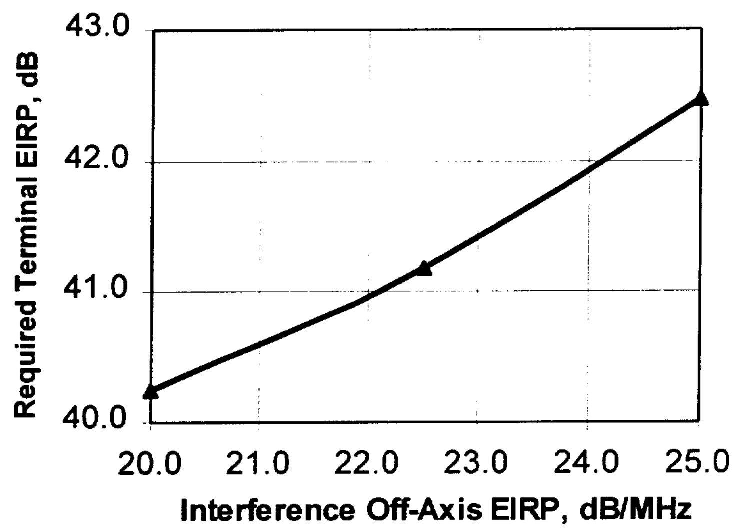


Figure 2. Link margin required (ordinate) for a given availability (abscissa) Down-link margin increase of 2 dB allows increasing availability from 99.7 to 99.8%

(c) Non Compliant Earth Station

The up-link off-axis EIRP density and down-link PFD threshold value described above would be used to permit blanket licensing of small earth stations. However, Hughes agrees with the FCC that earth stations could still be licensed to operate at higher up-link off-axis EIRP density or down-link PFD levels provided that these earth stations are successfully coordinated with affected satellite networks.

The coordination for these non-compliant earth stations should be done on a multilateral basis. It is our belief that the ASIA program has not been used for the non-compliant Ku-Band earth stations, because the database has never been updated. Therefore, Hughes proposes to use the multilateral coordination process as has been successfully implemented in the past.

(d) Antenna Pointing Requirements

Hughes proposes that the impact of earth station antenna pointing errors must be included in the maximum off-axis EIRP spectral density levels as proposed above. These levels must be met for the worst case pointing errors of the transmit earth station. In this way, the Ka-Band system operator has the flexibility to trade off the antenna off-axis gain performance and transmit power spectral densities against the factors that determine the antenna pointing accuracy (i.e., the design of the antenna mount design and the installation procedures). In other words, the end requirement is for the transmit terminal to meet a specific off-axis EIRP density coordination threshold. Because the threshold is a function of three factors: antenna off-axis gain, transmit power spectral density, and antenna pointing accuracy, the terminal operator has the freedom to decide on how to mix and match the three factors and how to assign certain weighting to each factor, as long as the threshold requirement is met at the end.

(e) Up-link Adaptive Power Control

The use of up-link power control to overcome rain fades is mandated in the Commission's 28 GHz First Report and Order and Section 25.204 of the Commission's Rules was amended to reflect that. Hughes agrees that the up-link power control implementation must not result in an increased adjacent satellite interference under rain fade (i.e. power up) condition, compared to the clear sky situation. It should be the responsibility of the applicant to maintain these clear sky off-axis EIRP density limits in all normal operating conditions. Since the licensee is required by the FCC Rules to assume responsibility for non-compliant interference into other systems, Hughes believes that the requirement to provide a technical description of the up-link power control system is unnecessary.

(f) Licensing Period

Hughes supports the FCC proposal of ten year blanket authorization under which each applicant could construct and operate a specified number and type of qualified earth station. This is consistent with the current Ku-Band blanket licensing procedures.

(g) Point of Contact Requirement

Hughes agrees with the FCC to have a point of contact for the GSO/FSS earth station network. But we do not agree with maintaining records on location and frequency use of these satellite earth stations. It would be too burdensome to maintain such a big database because of the large quantities of earth stations involved and also because of the temporary use of earth stations for some applications.

(h) Annual Report Requirement

Hughes supports the annual reporting procedures consistent with that used for Ku-Band blanket licensing.

ENGINEERING CERTIFICATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in this petition, that I am familiar with Part 25 of the Commission's Rules, that I have either prepared or reviewed the engineering information submitted in this application, and that it is complete and accurate to the best of my knowledge.

By: ____________________

K.S. Sahai
Advisory Engineer
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Hughes Network Systems

19 November 1998