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

In the Matter of	)	
	)	
The Establishment of Policies and	)	IB Docket 02-19
Service Rules for the Non-Geostationary	)	
Satellite Orbit, Fixed Satellite Service	)	
in the Ka-band	)	

COMMENTS OF HUGHES COMMUNICATIONS, INC.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY ii

I. SPECTRUM SHARING OPTIONS **1**

A. FLEXIBLE BAND SEGMENTATION (OPTION I) 3
B. DYNAMIC BAND SEGMENTATION (OPTION II) 4
C. AVOIDANCE OF IN-LINE INTERFERENCE EVENTS (OPTION III) 5
D. HOMOGENEOUS CONSTELLATIONS (OPTION IV) 7

II. COORDINATION BETWEEN SECOND-ROUND APPLICANTS AND TELEDESIC **11**

III. SERVICE RULES **17**

A. FINANCIAL QUALIFICATIONS 17
1. *The Commission's Financial Qualification Standard* *18*
2. *The Commission Has Twice Rejected Similar Financial Requirements Proposals.* *20*
3. *Alternative Means Of Oversight* *24*
B. IMPLEMENTATION MILESTONES 27
C. REPORTING REQUIREMENTS 30
D. CERTIFICATION OF MILESTONE REQUIREMENTS 31

IV. CONCLUSION **32**

TECHNICAL ANNEX ..... **I**

EXECUTIVE SUMMARY

Of the four spectrum-sharing options proposed in the NPRM, Hughes believes that Homogeneous Constellations (Option IV) is the option that would best support successful deployment of Ka-band NGSO FSS systems and also meet the Commission's stated policy goals. Because five of the six proposed Ka NGSO FSS systems are MEO systems, the various applicants are already significantly advanced toward a sharing solution based on a homogeneous MEO constellation. Once achieved, physical system coordination would allow all systems to operate across the entire Ka-band without ongoing, complex, and burdensome coordination. By contrast, neither Flexible Band Segmentation (Option I), nor Dynamic Band Segmentation (Option II), provides sufficient operating spectrum to a support technically and economically successful Ka-band NGSO FSS system. Avoidance of In-Line Interference Events (Option III) might allow all systems to operate, but would require ongoing and complex coordination, and also raises far greater interference and coordination issues than Option IV.

With respect to coordination between Teledesic and the second-round Ka-band NGSO applicants, Teledesic's January 31, 2002 modification application makes clear that Teledesic's system is flexible at this time. As such, there are no grounds for maintaining any priority for Teledesic with respect to its obligation to coordinate with second-round applicants. Furthermore, Teledesic's proposed modification may present a major system modification, which would require that Teledesic's application be considered in a third Ka-band NGSO FSS processing round.

As to issues raised by the Commission's proposed service rules, the Commission should not add a requirement of "commitment of funds not previously committed for any other purpose"[1] to the Commission's current financial qualifications standard. This unnecessary and unrealistic requirement has twice been considered and rejected by the Commission for reasons which are still valid today. The suggested addition is inconsistent with the policy underlying the financial requirements standard, and furthermore would impose unnecessary burdens on both the Commission and applicants. As an alternative means of oversight, Hughes proposes that a modified version of the current financial requirement standard would better serve the purpose underlying the current test. Requiring applicants to demonstrate the ability to fund a substantial portion of cost of construction, launch, and first year operation, combined with the Commission's milestone requirements, would identify adequately funded applicants, ensure timely system completion, and more closely reflect the current financial realities of financing global broadband satellite systems such as the pending Ka-band NGSO FSS proposals.

With or without financial requirements, Hughes supports the continued application of the current milestone requirements already set out in the Commission's rules. However, the proposed additional "bending metal" and CDR milestones are unwarranted, overly intrusive, and would result in an unnecessary drain on resources of both the Commission and applicants, and may have other negative effects. Adding such requirements seems especially inappropriate at a time when the Commission has acknowledged that milestone oversight has consumed enormous Commission resources,

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1 NPRM at ¶ 39.

and when the Commission has determined to undertake a broad review of milestones issues in general.

Hughes supports the Commission's proposal not to require reporting of unscheduled satellite outages. However, @contact's proposal to require quarterly status reports is an unnecessary and burdensome step backward, especially given that the Commission has recently eliminated the requirement to file semi-annual system status reports. Hughes also does not believe there is any need for the Commission to adopt new rules about milestone certification, because the Commission's general milestone certification requirement already applies to the Ka-band NGSO FSS.

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COMMENTS OF HUGHES COMMUNICATIONS, INC.

Hughes Communications, Inc. hereby submits its Comments in response to the Commission's Notice of Proposed Rulemaking[2] in this proceeding. Hughes is interested in this proceeding as the applicant for the Ka-band SPACEWAY NGSO satellite system,[3] which will be subject to the service rules adopted by the Commission.

I. SPECTRUM SHARING OPTIONS

The Commission asks for comment on four ways to assign spectrum to Ka-band NGSO FSS systems: (i) Flexible Band Segmentation, (ii) Dynamic Band Segmentation, (iii) Avoidance of In-line Interference Events, and (iv) Homogeneous Constellations.[4] The Commission outlines three principles that it seeks to advance,[5] and which Hughes fully supports: (a) the Commission's regulatory framework should not

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2 *The Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ka-Band*, FCC 02-30 (rel. Feb. 6, 2002) ("*NPRM*").

3 Application of Hughes Communications, Inc. for the SPACEWAY Satellite System, FCC File No. SAT-LOA-19971222-00210 (filed Dec. 22, 1997).

4 *See* NPRM at ¶ 18.

5 *See* NPRM at ¶¶ 16-19.

favor any particular technology or operational method, (b) the Commission should maximize spectrum availability for operational systems while accommodating the needs of all applicants, and (c) encouraging cooperation and negotiated arrangements between NGSO FSS applicants and licensees would serve the public interest.

Based on Hughes' review of the five systems currently proposed by each of the second-round applicants and the modified system proposed by Teledesic, Hughes believes that Homogeneous Constellations (Option IV) is the option that best fulfills the Commission's three stated principles and affords the most likely path for successful deployment of all proposed Ka-band NGSO FSS systems.

Neither Flexible Band Segmentation (Option I) nor Dynamic Band Segmentation (Option II) offers a practical solution for deployment of the proposed broadband systems. Assuming (as the Commission does) that all six proposed systems will become operational, neither of these options offers sufficient bandwidth to support commercial and practical operability of the proposed broadband systems. In addition, Dynamic Band Segmentation *reduces* available spectrum just as a system matures, and thus presents a serious obstacle to continued, successful operation of proposed systems. Avoidance of In-Line Interference Events (Option III) could allow for all proposed systems to be deployed, but only at the cost of significant coordination and operational complexity and, likely, significant system redesign. Because nearly all six pending Ka-band NGSO proposed systems are MEO systems with comparable proposed operating parameters,[6] establishment of a homogeneous MEO constellation would not appear to

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6 SkyBridge has proposed a LEO system, *see* Application of SkyBridge II FCC File No. SAT-LOA-19971222-00221 (filed Dec. 22, 1997); Teledesic's system, as currently licensed, is also a LEO system, but Teledesic has sought approval to

require major system redesign except in the case of one of the six systems. Once the applicants come to agreement on the physical coordination of their respective satellites in the homogeneous constellation, issues of radiofrequency coordination would essentially be resolved and would allow all applicants to use a maximum amount of spectrum without further operational restrictions.

A. Flexible Band Segmentation (Option I)

The major, and perhaps insurmountable, disadvantage of the Flexible Band Segmentation option is a limitation on the capacity of the system, and thus on the number of users that can be served, due to the severe limitation in assigned bandwidth. Simply put, guaranteed access to only 83.3 MHz of paired spectrum suitable for communications with ubiquitous earth terminals (assuming that the Commission accommodates all six applicants equally in the paired 500 MHz of NGSO primary spectrum at Ka-band) is insufficient -- both technically and economically -- to support any multi-billion-dollar advanced technology system designed to deliver broadband capability.

Further, the necessity of having numerous guard bands reduces the amount of spectrum that can be used for the provision of service, weakening the commercial viability of any related investment. The segmentation of each sub-band into separate sub-band segments for each applicant creates significant problems by increasing band-edge effects and limiting operational characteristics. At the very least, under this approach, some initial coordination between applicants would be required to determine guard band

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modify its system, in part changing it to a MEO system. *See Teledesic LLC, Modification Application*, File No. SAT-MOD-200220201-00011, (filed Jan 31, 2002) ("Teledesic Modification Application").

allocation and the type of filtering needed. However, the system applications on file do not include sufficient information to allow applicants to determine these necessary specifications, or to allow applicants to determine if, even with this information, the Flexible Band Segmentation proposal will support any of the proposed systems. Should the Commission continue to consider this option, it should encourage discussions between applicants before any final decision is taken so that, at the least, they can determine if this spectrum sharing option is potentially feasible.

B. Dynamic Band Segmentation (Option II)

To the extent that each licensed NGSO system ultimately obtains access only to its own portion of the NGSO band, this option ultimately raises many of the same issues as Flexible Band Segmentation. Additionally, the Dynamic Band Segmentation option results in more difficult frequency (and resource) planning and creates regulatory risk because when new systems become operational, existing systems will experience a series of reductions in bandwidth and capacity. This effect runs counter to business expectations in launching a new satellite system, namely that system capacity requirements will increase with time, as the system's customer base increases. Thus, while this option initially provides more capacity than Option I, it provides that capacity to the early operators at a time when more modest capacities are likely needed, and may not provide any more capacity than Option I as markets grow with time.

An additional deficiency is that reallocation of the band segments assigned to an existing operator each time a new operator becomes operational may require downloading of new software to the hundreds of thousands of user terminals, in order to

adjust the air interface parameters. This procedure would add significant operational complexity.

As noted above, each of Option I and Option II presents the possibility that a licensee may have access to only part of the NGSO FSS band that it needs to support the necessary investment in its system. However, additional bandwidth could become available if the other NGSO FSS systems either fail to launch, or do not fully deploy their systems. In that case, should the Commission continue to consider implementation of this option, Hughes urges the Commission to make this spectrum available to those first and second round NGSO FSS licensees who actually implement their systems, instead of setting it aside for new applicants. Hughes therefore believes that any first or second round licensee who actually deploys an NGSO FSS system will likely do so only if the possibility exists that it can gain access to any spectrum assigned to those systems that are not implemented.

C. Avoidance of In-Line Interference Events (Option III)

The Avoidance of In-Line Interference Events option could permit a significant reduction in interference, especially if combined with link control techniques (such as power control), but any such benefits would come at the cost of a significant increase in system and user terminal complexity and increased inter-system coordination. Under this option, when an in-line event occurs, either a handoff is required to another satellite (satellite diversity), or frequency isolation needs to be employed, or transmission from the interfering terminal must be shut off for the duration of the in-line event. This mitigation technique requires close coordination between the interfered-with and interfering NGSO systems, including an exchange of ephemeris data that has to be

distributed to the user terminals, resource and mobility management that must be coordinated between the two systems, and handoff that must be carried out during the exclusion event. All of these procedures place significant additional burden on the NGSO networks and result in a reduction in capacity of each network, especially for uneven traffic distributions.

As an initial matter, Hughes notes that this option may impose unequal burdens on systems depending on their overall design. For example, "full-mesh" systems or other systems that rely on numerous, small earth stations communicating with each other may be harder pressed to mitigate in-line interference events than systems designed around gateway terminals. For example, near a populated urban area (*e.g.*, New York City), a system employing gateways may have little or no trouble avoiding interference, since it would likely have a small number of gateway stations to serve the entire area. However, a "full-mesh" system with a large number of active user terminals would have to be able to coordinate and effect handoffs or frequency isolation for a great number of end-user terminals simultaneously. This frequency coordination function could easily exceed system capabilities or capacity. In addition, the information required for coordination alone would create a significantly disproportionate burden on operators of these systems.

Consistent with the Commission's articulated licensing principles,[7] the Commission should take care not to disadvantage system designs that utilize a "full mesh" approach over systems that utilize a gateway-driven approach. Full mesh systems offer considerable flexibility for deployment and redeployment of capacity as markets

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[7] *See* NPRM at ¶ 13.

grow and evolve, and although gateway-driven systems also have advantages, the Commission should not inadvertently preclude one approach or the other in selecting a licensing approach.

Although the interfering system could have uniformly distributed earth stations, actual terminal distributions may have highly non-uniform concentrations of user terminals located in and around metropolitan areas. This clustered distribution of user terminals will place burdens on the satellite network that needs to carry out handover or frequency isolation quickly for large numbers of ground terminals to avoid an in-line interference event. The complexity of this entire process will also increase significantly over time as additional systems are brought into use. Studies that utilize more realistic terminal distributions are needed to properly assess the feasibility of this option.

With regard to the Teledesic proposal of a "+/-" 10 degrees avoidance angle,[8] it is clear from Table 2 of ITU-R Working Party 4A Document 4A/TEMP/81 that avoidance angles as large as twenty degrees may be needed, especially between LEO/MEO or LEO/HEO systems using this sharing technique for I/No values of 0 dB. However, Hughes does agree in concept with the idea that link control techniques might need to be employed because these techniques appear to offer significant reductions in interference for in-line events.

D. Homogeneous Constellations (Option IV)

This spectrum sharing technique would lead to acceptable interference levels, with significantly less complex operational procedures for user terminals than the In-Line Event Avoidance option for the set of applications in this proceeding. This

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8 *See* NPRM at 30; *see also* Comments of Teledesic LLC, IB Docket No. 01-96 (Filed July 5, 2001).

option will require coordination between operators, both in the design and operation of the systems.[9] However, unlike the situation the Commission and the NGSO FSS applicants faced in the Ku band, here every proposed system, with the exception of the LEO system proposed by SkyBridge, is a MEO system.[10] This means that five of the six proposed systems are already significantly well advanced toward a coordinated solution. If only MEO NGSO constellations were deployed, and all systems had harmonized constellations within this class, then Hughes believes that the spectrum sharing problem could readily be resolved, and each system could have access to a full 500 MHz of spectrum in both up and downlink directions all of the time.[11] Access to this amount of spectrum is essential to providing each operator the best opportunity for commercial success.

A preliminary analysis conducted by Hughes indicates that the interference environment for the case of different MEO systems operating with different

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9 To be effective, coordination (especially in the context of Option IV, but equally important for any of the three other options) should be undertaken as soon as practicable to ensure that coordination will be effective, and to minimize delays and costs associated with system redesigns, which become significantly more challenging as all operators move forward with their systems. Given this reality, delayed coordination (such as @contact's proposed "band segmentation with coordination," where coordination is deferred until issuance of second-round licenses, *see* NPRM at ¶ 22) would appear to be counterproductive.

10 As noted above, Teledesic's currently licensed system is a LEO system, but Teledesic's recently reconfigured system is a MEO system.

11 The Commission notes that all Ka-band NGSO systems will be required to coordinate with Federal Government GSO and NGSO systems operating throughout the 17.8-20.0 GHz frequency band, *see* NPRM at ¶¶ 17, 45. These Government systems will have a significant but largely unknown potential impact on the coordination and operation of all Ka-band NGSO systems, and may affect the analysis of the proposed spectrum-sharing options.

constellation parameters varies greatly over time, and for different geographical locations. As can be seen in the attached Technical Annex, the Carrier-to-interference (C/I) ratio for this case of systems with independent constellations varies significantly over time for earth stations at different locations, and in fact drops as low as 10dB and below at times. While Hughes is not proposing a specific interference threshold at this time, it is clear from these results that for this case, there are times during which received interference levels would be considered unacceptable and some form of interference mitigation would therefore be required. Aside from the obvious problems raised during times with such extremely high interference levels, the wide variability in received interference level itself (up to and beyond 30 dB) will make issues of coordination much more complex and may unequally affect users and operators of different systems.

This result is contrasted with that obtained when the various proponent system parameters are modified slightly to allow the systems to fit into a homogeneous constellation. In this case, the results indicate that the interference environment is far more settled. It can be seen that the received interference level varies by about 5 dB over time, and that there is little difference in the interference environment for different terminal locations. In addition, the aggregate interference environment is such as to result in acceptable levels of interference over time (C/I ratio of around 30 dB for two systems and 27-28 dB for 3 systems), for all locations. While not an exhaustive study, these results demonstrate that there is great promise for maximizing the spectrum utilization of multiple NGSO FSS systems when a homogeneous constellation is used.

Providing for homogeneous systems would ensure a number of advantages. First, as all systems would employ similar power levels, the interference

environment would be materially improved. In addition, all systems would have access to the entire paired 500 MHz of Ka-band spectrum all of the time. This is a significant advantage given that, under either Option I or Option II, there is simply not sufficient spectrum to allow all systems to operate effectively. Access to all of this Ka-band spectrum also supplies the one advantage of Dynamic Band Segmentation (full spectrum access to the first-operating system) without any concomitant reduction in spectrum access as new systems are brought into operation. As additional systems are brought on-line, the background C/I ratio would be reduced, but should remain at an acceptable and consistent level, without the reduction of spectrum or usage time created by the other three options.

Homogeneous constellations would also eliminate in-line interference events, because by design the systems would be designed and physically coordinated to avoid such events. This places much less of a burden on the network and network management, as well as on the user terminals. Once the homogeneous constellation is designed network control is much simpler than for the in-line avoidance technique. Operators would be relieved of the continuing and serious burden of coordinating these events for user terminals, and systems would be able to more easily provide consistent and interference-free operation for consumers. An added benefit would be that, compared to the location-specific interference environment which would exist under each of the first three options, with homogeneous constellations the interference environment appears to be *location-independent*.

Of course, if the Commission decides to implement this option, in one form or another, the Commission must, as it has done in the past, provide all Ka-band

NGSO FSS applicants the opportunity to amend their applications to take into account the constellation type or types selected by the Commission under its modified service rules. This would be done after the applicants have completed negotiations on the details of the homogeneous constellation parameters.

II. COORDINATION BETWEEN SECOND-ROUND APPLICANTS AND TELEDESIC

The Commission seeks comment on the issues of spectrum sharing and coordination between the second-round Ka NGSO applicants and Teledesic.[12] The Commission also seeks comments on the specific issue of how the second-round applicants' duty to coordinate with Teledesic might affect the proposed spectrum sharing options.

Teledesic's January 31, 2002 application for authorization to modify its licensed system[13] significantly alters this analysis. Teledesic's second significant system redesign in five years means that there is no justifiable basis for providing Teledesic with *any* coordination priority over any second round Ka-band NGSO applicant. Teledesic's system design is clearly flexible at this time; in fact, the most recent modification application demonstrates that the Teledesic system is, almost five years after having been licensed, still in the very early stages of development.

Pursuant to Teledesic's first system modification, approved two years after Teledesic originally was authorized, Teledesic reduced its constellation from 840 to 288 low earth orbiting (LEO) spacecraft; increased the altitude of the constellation; decreased the number of orbital planes; decreased the inclination of the orbital planes; added

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12 NPRM at ¶ 14.

emission designators; added optical inter-satellite links ("ISLs"); changed its downlink modulation; and changed its uplink and downlink power budgets.[14]

As proposed in its January 31, 2002 modification application, Teledesic's system would change fundamentally once again. The new system would be drastically reduced, this time to a constellation of 12, then later a further 18, medium earth orbiting (MEO) spacecraft, operating at yet higher altitudes than the 288 or 840 satellite constellations.[15] In addition, among other changes, the constellation will include two wholly new types of spacecraft (12 simple 4-beam bent pipe satellites and 18 more sophisticated multi-beam bent pipe satellites); the entire system is proposed to be introduced in two phases; the ISLs—introduced under the 1999 modification—are now eliminated, and the gateway station operation has been moved into the user terminal spectrum from the so-called "gigalink" spectrum (i.e. 27.6-28.4 GHz (E-s) and 17.8-18.6 GHz (s-E)).[16] For all intents and purposes, this is an entirely different system design and service introduction approach from both of Teledesic's previously licensed NGSO system designs.

Naturally, Teledesic's reconfigured system will present issues of coordination for second-round applicants. As noted below, Teledesic has not provided an interference analysis based on its proposed, reconfigured system. This fact makes it impossible to conclude at this time whether the proposed modification would aid or

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13 *See Teledesic LLC, Modification Application*, File No. SAT-MOD-200220201-00011, (filed Jan 31, 2002) ("Teledesic Modification Application").

14 *See In The Matter Of Teledesic LLC For Minor Modification Of License To Construct, Launch, And Operate A Non-Geostationary Fixed Satellite Service System*, DA 99-267 (released January 29, 1999) ("Teledesic 1999 Modification Order").

15 *See* Teledesic Modification Application at A-1, A-2.

16 *See id.,* at A-3 –A-15.

hinder coordination. However, Teledesic's proposed modification will result in a MEO system, which, as discussed above, militates in favor (at least as an initial matter) of the Homogeneous Constellation spectrum sharing option. In turn, physical system coordination among MEO systems, once accomplished, would result in a much simpler RF coordination environment.

However, the real question currently facing second-round applicants and the Commission is whether Teledesic should be considered on an equal footing with second-round applicants for purposes of coordination, or whether Teledesic's application presents a major system modification, which would require Teledesic to shoulder proportionately more of the coordination burden than the second-round applicants. This issue has also been briefed in comments on Teledesic's modification application.

A. Teledesic Should Have No Priority Over Second Round Ka-Band NGSO FSS Applicants With Respect To Spectrum Sharing And Coordination.

The Commission proposes to license all five pending NGSO FSS applicants, "bearing in mind the Commission's previous authorization to Teledesic."[17] Naturally, the potential for six NGSO FSS systems operating co-frequency at Ka-band raises coordination and spectrum sharing issues, as the Commission has recognized. The Commission has already determined that it expects "all NGSO FSS licensees [at Ka-band] to be responsible for some portion of the burden-sharing"[18] of coordinating

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17 NPRM at ¶2.

18 *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 Of Local Multipoint Distribution Services And For Fixed Satellite Services*, 12 FCC Rcd 22310 at ¶38 (1997) ("*Third Report and Order*")

multiple system entry, which may include negotiations and possibly extensive system design modifications.

Teledesic is not, by virtue of having the first U.S.-licensed Ka-band NGSO FSS system, in any way exempt from the duty to coordinate. To the contrary, the Commission has expressly directed Teledesic to "share the burden of coordination with other NGSO FSS systems and to coordinate in good faith."[19]

In fact, the Commission has made clear that the extent to which a party will be obligated to coordinate with other systems (i.e. the extent to which a party would be obligated to negotiate, and possibly redesign its proposed system) is not based on whether it is licensed in the first or second processing round, but rather on its progress in construction of its licensed system. The Commission has indicated its intention that although all Ka-band NGSO systems share responsibility for coordination, "licensees that have made progress in system implementation should not have to significantly alter or redesign their systems to accommodate later applicants."[20]

The Commission has expressly tied the extent of Teledesic's coordination obligation to Teledesic's progress in completing its licensed system. As the Commission explained:

> We recognize that...a licensee that has already contracted for and constructed major components into its authorized system would not have the same degree of flexibility to redesign its system as would entities not yet or newly licensed. Consequently, to the extent Teledesic is proceeding with construction of its licensed system, subsequently licensed systems would be obligated to coordinate with Teledesic. Conversely, in the event Teledesic should seek to modify its system's parameters instead of constructing its system as authorized,

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19 *In The Matter Of Teledesic LLC [Application] for Minor Modification of License to Construct, Launch and Operate a Non-Geostationary Fixed Satellite Service System*, 14 FCC Rcd 2261, at ¶23 (released January 29, 1999).

20 NPRM at ¶7.

> we would find that Teledesic would be in a much better position to make changes to facilitate coordination and accommodate new entrants. If Teledesic were to significantly alter its system design at this point, it would indicate that Teledesic has not made the kind of progress that would limit its flexibility to incorporate design changes into its systems. In this case, sharing the burden equally with new entrants may not impede its progress in implementing its system.[21]

The Commission echoes this language in the NPRM, stating that

> ...we recognize that the farther along a licensee is in the construction of its system, the less flexibility it has to redesign its system to accommodate new entrants. For example, if Teledesic, which was first licensed in 1997, had already contracted for and constructed major components of its authorized system, it would not have the same degree of flexibility to redesign its system as would entities not yet licensed. Conversely, if Teledesic has not yet finalized its systems parameters, as would be evidenced by a subsequent application to modify its licensed system, we would view Teledesic in a much better position to make additional changes to facilitate coordination with additional systems.[22]

Teledesic's January 31, 2002 application for authority to modify its system—its second such application since its original 840 satellite system was authorized in 1997—demonstrates that Teledesic is in as good a position to modify its system for purposes of coordination as any second round applicant. Since the system was authorized almost five years ago, the only progress Teledesic appears to have made is to have entered into a construction agreement for two substantially simplified spacecraft the day before it filed its modification application.

There is simply no reason to accord Teledesic any priority whatsoever with respect to its obligation to coordinate this new design with other U.S.-licensed Ka-

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21 *In The Matter Of Teledesic Corporation Petition For Clarification And/Or Reconsideration, 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 Of Local Multipoint Distribution Services And For Fixed Satellite Services,* CC Docket No. 92-297, FCC 02-6, at ¶9 (released February 6, 2002).

22 NPRM at ¶ 14.

band NGSO systems. In fact, to the extent this modification proposal presents significant interference problems for second round Ka-band NGSO applicants, it should be considered a newly filed application to be addressed in a third Ka-band NGSO processing round.

B. Teledesic's Proposed System May Constitute A Major License Modification.

The Commission has consistently granted applications for system modification unless such modifications would present significant interference problems or otherwise conflict with Commission policies.[23] However, when modifications present significant interference problems, the Commission treats the request for modification as a newly-filed application to be considered during a subsequent processing round.[24] If Teledesic does not satisfy the Commission that its proposed modification will not create significant interference problems to the second round applicants,[25] then Teledesic's modification application should be treated as a newly-filed application in a third Ka-band NGSO FSS processing round.

As Hughes has stated in its Comments to Teledesic's Modification Application, the Commission should require that Teledesic furnish a detailed interference analysis and allow all interested parties an adequate opportunity to review and comment

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23 *See, e.g.*, Teledesic 1999 Modification Order at ¶ 5

24 *See id.*

25 Potential problems include (1) longer in-line-interference events due to the use of slower orbiting spacecraft, (2) spacecraft communicating with user earth station antennas at apparently lower elevation angles, (3) higher required transmit powers from user terminals in order to communicate with higher altitude spacecraft, (4) addition of gateway earth station operation down to elevation angles of 20 degrees into the user terminal bands.

on that analysis.[26] Until such a showing has been made, it is not possible to determine whether Teledesic should be treated as being on a equal footing with the second-round Ka NGSO applicants, or whether Teledesic should be treated as a third-round applicant.

III. SERVICE RULES

A. Financial Qualifications

The Commission indicates that, should a spectrum-sharing plan prove incapable of accommodating all applicants, the Commission will apply a financial qualifications test, an historical tool for use when potential applicants have requirements that apparently exceed the available orbital or spectrum resources.[27] In such a case, the Commission proposes to apply its current requirement[28] of demonstrating internal assets or committed financing sufficient to cover costs of construction, launch, and first year operation for the entire system. However, the Commission further proposes to require "the commitment of funds not previously committed for any other purpose," which funds would be "separate and apart" from funds required by the applicant for any other licensed system.[29]

The Commission's current financial qualification standard has applied to FSS systems since 1985 and generally has proven effective. As noted below, however, the application of such a test in the case of global NGSO systems is not appropriate. Rather, some modified form of this standard may be more suitable.

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26 *See* Comments of Hughes Communications, Inc., File Nos. 22-DSS-P/LA-94; 43-SAT-AMEND-95; 127-SAT-AMEND-95;195-SAT-ML-97 (filed March 18, 2002) at 5-7.

27 NPRM at ¶¶ 38-39.

28 *See* 47 C.F.R. § 25.140(c).

29 NPRM at ¶ 39.

By contrast, the "allocation of previously uncommitted funds" proposal in the NPRM is an unnecessary and unrealistic requirement that the Commission has already twice considered and rejected. The reasons for the Commission's rejection of this approach still hold true today. Such an approach is inconsistent with the policy and purpose of the Commission's financial qualifications standard, ignores the realities of business generally and the satellite industry in particular, and would impose unnecessary burdens on both applicants and the Commission.

1. *The Commission's Financial Qualification Standard*

The Commission's financial qualification standard was first developed in the Domestic Fixed-Satellite Service proceeding in 1985. In 1983, the Commission initially required that an applicant demonstrate its financial qualifications, as well as "an ability to proceed promptly with construction and launch of the proposed satellites."[30] In 1985, the Commission clarified and explained the financial qualification standard,[31] requiring that applicants "demonstrate the financial capability to construct, launch, and operate for a year their proposed systems immediately upon grant."[32] The Commission explained that applicants could demonstrate their financial capability by supplying

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30 *In The Matter Of Filing Applications For New Space Stations In The Domestic Fixed-Satellite Service*, 93 F.C.C. 2d 1260, April 27, 1983, at ¶ 4 ("*1983 Processing Order*.")

31 *In The Matter of Licensing Space Stations In The Domestic Fixed-Satellite Service*, CC Docket No. 81-704, 58 Rad. Reg. 2d, (P&F)(1985)("*1985 Licensing Order*").

32 1985 Licensing Order at ¶ 11.

documentation of internal funds (current assets or operating income) or committed and non-contingent financing from outside sources.[33]

As the Commission has consistently explained, the financial qualification policy is designed "to make efficient use of spectrum by preventing underfinanced applicants from depriving another fully capitalized applicant of the opportunity to provide service to the public."[34]

The Commission's practice of examining internal financial resources is properly tailored to the goals of the financial qualification standard because it provides a means to assess the ability of the applicant to raise the needed financing and deploy the system.[35] Under the Commission's longstanding approach, "current financial capability" as indicated by current assets (or operating income) means *funds or the demonstrated capability to obtain funding*. As the Commission explained in the 1985 Licensing Order,

> The availability of internal funds sufficient to cover the system's investment and first-year operating costs provides adequate assurance that the system can be built and launched. *Current assets. . . provides a measure of a company's ability to raise funds*

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33 1985 Licensing Order at ¶ 13-14.

34 NPRM ¶ 52. *See also, e.g., In The Matter Of Amendment To The Commission's Rules To Allocate Spectrum For, And To Establish Other Rules And Policies Pertaining To A Radiodetermination Satellite Service*, Gen. Docket No. 84-690, 104 F.C.C. 2d 650 (1986), at ¶ 23 ("*Radiodetermination Order*") (financial qualifications test "ensures that the orbit-spectrum resource is not tied up by entities unable to fulfill their plans, and also serves to discourage the filing of speculative applications").

35 "[T]he availability of internal funds sufficient to cover a system's costs provides adequate assurance at the time the Commission acts on the application that the system can be built and launched." *In the Matter of Amendment of the Commission's Rules To Establish Rules And Policies Pertaining To A Mobile Satellite Service In The* 1610-1626.5/2483.5-1500 MHz Frequency Bands, CC Docket No. 92-166, 9 FCC Rcd 5936 (1994), at ¶31 ("*Big LEO Order.*") "[A] determination of an applicant's financial ability helps to ensure that service is promptly made available to users." Radiodetermination Order at ¶ 23.

> *on the basis of its on-going operations*. This measure is one we have used since 1983. . . and is an indication of a company's ability to finance its system promptly upon grant.[36]

Thus, the Commission's existing, time-tested financial qualification standard is appropriately targeted at the policy goals identified by the Commission in the NPRM.

2. *The Commission Has Twice Rejected Financial Requirements Similar to The Current Proposal.*

In the 1985 Domestic FSS NPRM, the Commission proposed a requirement that would have required a specific allocation of otherwise "uncommitted capital assets" to the proposed system together with "an explicit commitment from management that these assets will be used for the proposed satellite system."[37] For reasons that are equally valid today, the Commission rejected that approach.

This previous proposal was essentially the same as the Commission's current proposal requiring "a commitment of funds not previously committed for any other purpose" that would be "separate and apart" from funds required for operation of other systems.[38] In both cases, the applicant would be required to identify and commit funds sufficient to support the proposed system, which funds presumably would not be available for any other use thereafter. Under such a proposal, and contrary to the Commission's customary approach, an applicant's "current financial capability" presumably would be determined by measuring specifically allocated funds against the costs of construction, launch and maintenance.

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36 1985 Licensing Order at ¶ 13.

37 1985 Licensing Order at ¶ 12.

38 NPRM at ¶ 39.

In the 1985 Licensing Order, the Commission rejected the "committed funds" proposal as being both unnecessary and impractical. Most important, the Commission made clear that requiring applicants to set aside funds specific to the project did not further the goals of the financial qualification requirement, because the commitment of specific funds "provides little additional assurance that the system will in fact be built."[39]

The Commission acknowledged that the extra requirement was unrealistic given the realities of the satellite industry and general business practices. The Commission noted and concurred with comments explaining that companies might not be willing or able to set aside specific assets for projects possibly more than three years in advance, and that an unalterable commitment of such funds would not be practical given the realities of business and credit arrangements.[40]

The Commission revisited the issue of strict financial qualifications in the "Big LEO" proceeding in 1994 and *again* rejected a proposal that would have required proposed systems to be supported by a showing of specific, earmarked funds.[41] Instead, the Commission adopted an identical standard to the one it had outlined in the 1985 Licensing Order.[42] The Commission reaffirmed that an applicant's current assets are examined because they indicate that applicants have or can raise the necessary capital:

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39 1985 Licensing Order at ¶ 13.

40 1985 Licensing Order at ¶ 12.

41 In response to a proposal that management commit funds specifically to the applicant's proposed Big LEO project, the Commission concluded, "[a]s we stated in adopting the domestic fixed-satellite standard, we will not require management to set aside specific funds for the system." Big LEO Order at ¶35.

42 Big LEO Order at ¶ 30.

> ...[A]s in the domestic fixed-satellite service, we require only a demonstration of current assets or operating income sufficient to cover system costs. *Current assets . . . provide a general measure of a company's ability to finance the project itself or to raise funds from lenders and equity investors on the basis of its on-going operations.*[43]

While the Commission has rejected the "separate funds" proposal as inappropriate and unnecessary in both the Domestic FSS and Big LEO proceedings, other factors weigh against the new proposal as well.

Requiring committed and specific allocation of funds to a proposed Ka-band NGSO FSS project would entail significant administrative and managerial burdens on applicants. Documentation of current assets or operating income on a yearly balance sheet requires little or no additional effort on the part of an applicant. However, identification of funds allocated specifically to the Ka-band NGSO project, as well as continuing documentation of all the other funds and assets from which the Ka-band funds must be "separate and apart" requires significant and ongoing effort and reporting. Depending on an applicant's corporate structure, accounting procedures, and internal audit or reporting procedures and schedule, this process could impose significant costs and effort.

Reporting and monitoring costs, however, would be minor compared to the indirect effect such a requirement would have on an applicant's ability to do business. The requirement to lock up enormous quantities of funds or commit assets for significant periods of time would seriously hamper an applicant's management flexibility in other areas, and may paradoxically create obstacles to the prompt deployment of the proposed

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43 *Id.*

Ka-band NGSO systems.[44] The allocation of assets in this manner may hinder an applicant's ability to obtain financing, could be prohibited by credit and other financing agreements already in place, and could conflict with existing agreements. Moreover, such a requirement would be ill-advised from a money-management perspective and may result in a less than optimal use of funds on hand. In addition, reporting internal allocations of funds and assets is unnecessarily intrusive and requires unwarranted disclosure of corporate processes and strategy, which could have negative financial and competitive effects on the applicant.

The proposed requirement would impose unnecessary and serious administrative burdens on Commission staff. The Commission wisely declined in 1985 to take on the additional task of "a rigorous and burdensome parsing of applicants' financial statements."[45] If the Commission truly wished to determine that funds were allocated exclusively to a Ka-band NGSO project, staff would have to essentially maintain an open audit of the applicant's finances. A mere statement on an applicant's balance sheet or other document that certain funds were allocated to the proposed project could not ensure that the requirement was being met. To fully enforce the new requirement, the Commission would need extensive and ongoing documentation of cash outlays, evidence of authorized charges against the proposed project, balance transfers between subsidiaries and departments, and other sensitive financial details.

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44 For example, assets required to be committed exclusively to the proposed project presumably would not also be permitted to serve as collateral for secured financing, could not be allocated to R&D costs common to two projects, and could not be used to pay off debts and improve future credit terms.

45 1985 Licensing Order at ¶ 10.

Finally, the increased burden imposed on applicants and Commission alike would be wholly unnecessary. Unless the commitment of funds (and the Commission's oversight of the applicant's finances) imposes a continuous obligation, it will be meaningless. As the Commission noted in the 1985 Licensing Order, "management can withdraw a commitment as easily as it can make one, and therefore this commitment provides little additional assurance that the system will in fact be built."[46] Even as a continued (and far more burdensome) obligation, the requirement will not add any meaningful information to help distinguish between those applicants who have the current financial ability to proceed with their systems and those who will spend a great deal of time seeking financing and possibly never succeed.

Because the significant burdens of the proposed additional "committed funds" requirement would not provide any concomitant benefit to the Commission or the public, the Commission should reject the proposal as it has done twice in the past.

3. *Alternative Means Of Oversight*

Application of the Homogeneous Constellation option, together with a cooperative spectrum sharing agreement among all Ka-band NGSO applicants in the second processing round and Teledesic, should obviate the need for strict financial qualifications. However, in the event that such an agreement is not reached, or the Homogeneous Constellation option is not selected, Hughes proposes an alternative means of oversight to ensure that licensees will timely commence service.[47]

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46 1985 Licensing Order at ¶ 13.

47 *See* NPRM at ¶ 39.

Hughes has long supported the application of financial qualifications as a means of ensuring that only those applicants likely to complete their proposed systems are licensed. The Commission's current financial qualifications test -- which focuses on current assets and operating income -- is a well-crafted response to the types of satellite systems for which it originally was developed.

However, the current standard was developed when satellite licensees were launching a handful of spacecraft at a time -- one or two spacecraft at a time was the norm. Under such circumstances, requiring internal funds or committed financing sufficient to cover 100% of the costs made sense. By contrast, the global, multi-spacecraft networks proposed in this processing round are enormously more expensive, complex and interdependent. The industry's experience with the "Big LEO" systems testifies to the fact that these types of networks can be realized only by extensive, global partnerships or by completely different funding strategies.

Teledesic's modification application provides a case in point. Teledesic proposes a "phased deployment," whereby an initial deployment of 12 spacecraft would "provide a revenue base to help fund the deployment" of the remaining 18 satellites in the constellation. It is highly unlikely that this approach would meet the Commission's proposed "previously uncommitted funds" requirement. To the contrary, it seems designed purposefully to eliminate the need for Teledesic to either set aside funds sufficient to support the entire system or to obtain an equivalent amount of financing. Yet Teledesic's plan (regardless of the eventual outcome) is a rational business reaction to current economic reality and the nature of the proposed system. Teledesic's "phased"

proposal is based on the enormous cost of deployment of a global NGSO system, as well as by the realities of the current financial markets, as Teledesic clearly explains.[48]

Because systems of the type proposed in this proceeding must, as a practical matter, be developed though strategic partnerships, complex funding arrangements, or alternative strategies such as Teledesic's, it is not feasible to expect a Ka-band NGSO applicant to be able to show the financial capability to fund the full system by itself. Such a requirement would be out of step with the present realities of the industry and would fail to identify those applicants that have the ability to generate the funding required or to enter into the types of alliances that will facilitate system deployment.

Instead, for the types of multibillion-dollar global systems proposed in this proceeding, the Commission should consider an alternative requirement *combining* financial qualifications with the current milestone requirement. As an initial matter, an applicant should be required to demonstrate internal funds (including that of its parent companies) or committed financing totaling a substantial portion, such as 25%, of the cost of construction, launch, and first-year operation. Such a threshold would be consistent with the original purpose of the rule -- measuring the ability to raise funds from financial supporters. Furthermore, such a threshold would more closely reflect the risk and investment analysis process that actually occurs in capital markets. Venture capitalists, banks, and other lenders naturally do not require businesses to have or commit all the funds necessary for a project; rather, they select businesses that have a sufficient stake in the enterprise to reasonably ensure success and invest accordingly. Ensuring that

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48 *See* Teledesic Modification Application at A-26, A-29-31.

the licensees actually proceed and raise the required funding could be satisfied by the Commission's current milestones requirement. Together, these requirements would facilitate the development of global broadband systems, and provide the Commission with the ability to modify or cancel the licenses of those not proceeding with deployment.

This modified requirement would fit better with the present financial reality of the satellite industry and would allow increased competitive flexibility, thus better serving the public interest. Requiring huge amounts of funds to be tied up for the several years involved in the satellite licensing process, as proposed in the NPRM, paradoxically would inhibit the creation of the partnerships necessary to support the development and deployment of global satellite networks, and therefore would militate against a competitive growth environment in the satellite industry. The modified standard proposed here would better serve the Commission's goal of ensuring that licensees are able to and do use those resources to actually provide service to the public.

B. Implementation Milestones

Hughes agrees with the Commission that Ka-band NGSO FSS licensees should "adhere to a strict timetable for system implementation."[49] Implementation milestones are an effective way to ensure that licensees are building their systems in a timely manner and are not warehousing spectrum that could be used productively by other entities.

However the implementation milestones set out in §25.145(f) of the Commission's rules were adopted in 1997 to expressly apply to the Ka-band NGSO

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49 NPRM at ¶ 40.

FSS.[50] The Commission's rules already set the timetables for construction and launch of spacecraft and for operation of the complete system.[51] The Commission's rules also require certification of the completion of construction and other milestone requirements.[52] These rules were already in effect when all the second-round applicants filed their applications. There is no reason that these existing rules should not apply to second-round Ka-band NGSO FSS applicants just as they already apply to Teledesic; certainly, there is no apparent reason to modify the existing rules to apply *additional* requirements only to second-round applicants.

In addition, Hughes does not support the more detailed "bending metal" and CDR interim milestones that the Commission proposes to add in the NPRM.[53] These additional milestones are unwarranted, overly-intrusive and will be an unnecessary drain on Commission resources.

A general requirement that a licensee enter into a binding, non-contingent construction contract[54] would ensure that the licensee will begin construction promptly upon grant and complete construction within the time frame specified in its authorization. Contracts that provide fixed construction timetables, payment schedules, and financial penalties for non-performance provide all the necessary incentives and obligations to

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50 *See* 47 C.F.R. §25.145(f). By its own terms, §25.145 applies to "Fixed-Satellite Service in the 20/30 GHz bands." 47 C.F.R. §25.145(a).

51 *See* 47 C.F.R. §25.145(f).

52 *See* 47 C.F.R. §25.161(a).

53 *See* NPRM at ¶ 40.

54 *See, e.g., In the Matter of Columbia Communications Corporation*, DA-01-1241 at ¶ 9 (2001) ("*Columbia Order*"); *In the Matter of PanAmSat Licensee Corp.*, 15 FCC Rcd 18720 at ¶ 8 (2000); *In the Matter of Norris Satellite Communications, Inc.* 12 FCC Rcd 22299 at ¶ 9 (1997).

licensees and adequately ensure completion by the milestone date. Timely commencement of physical construction and completion of critical design review are covered in these contracts and therefore inherent in any "construction commencement" milestone requirement.

The current milestone requirement should provide sufficient and early information from the applicants in this processing round. As the construction requirements are already covered and the Commission already receives timely information from the construction commencement milestone, there is simply no added benefit from the additional interim showings.[55]

Besides being unnecessary, the proposed interim requirements would be intrusive and burdensome on operators, without adding assurance that the systems actually will be timely deployed. These additional milestones would involve the Commission in counterproductive micro-management of licensees and require a level of detailed oversight that would hamper applicants without adding any further assurance to the Commission's oversight process. Besides imposing additional costs on applicants, these interim requirements would necessitate the disclosure of sensitive information, which could have anti-competitive effects, and possibly ITAR-controlled information as well.

Furthermore, application of these proposed additional milestones to second-round applicants, but not to Teledesic, would be illogical and unfair. This is

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55 The Commission's proposal to utilize the ITU "bringing into use" date, NPRM at ¶ 41, would not be useful. Demonstrating that an applicant has a place on a launch manifest seven years before scheduled launch is not likely to add any assurance that implementation is proceeding in a timely fashion or that the system will be completed and launched as required.

especially true given that, due to Teledesic's recent significant system re-design, Teledesic has hardly relied on its licensed system parameters. Just as there is no basis for Teledesic's having any priority with regard to coordination with second-round applicants, there is also no reason to allow Teledesic to rely on the current milestone requirements while requiring second-round applicants to shoulder a heavier compliance burden.

Finally, such additional milestones would needlessly require more of the Commission's effort and time than in the past. The Commission has previously noted that "enforcement of milestones has increasingly required a significant investment of limited Commission time and resources that may be better spent on other proceedings."[56] Adding the proposed interim milestones would be completely counter to the "minimalist" approach to milestones previously suggested by the Commission.[57] The effort and time spent overseeing and, quite likely, litigating the interim milestones, could be well spent otherwise. The Commission will have adequate opportunity to determine whether it wishes to allocate even more resources to milestone review when it initiates its upcoming broad review of milestone issues.[58]

C. Reporting Requirements

Hughes supports the Commission's proposal not to require reporting of unscheduled satellite outages.[59] As the Commission notes, current spectrum resource availability make such a requirement unnecessary. The existing reporting requirements alone will sufficiently protect the public interest and promote utilization of spectrum and

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56 *See Establishment Of Policies And Service Rules For The Non-Geostationary Satellite Orbit, Fixed Satellite Service In The Ku-Band*, FCC 01-134 (rel. May 3, 2001) ("*Ku Band NPRM*")

57 Ku Band NPRM at ¶ 57.

58 *See* NPRM at ¶ 41, n. 63.

orbital resources by providing adequate information to the Commission to determine whether system development is proceeding as required.

In contrast to the Commission's ongoing efforts to streamline the rules and regulations applicable to satellite systems, @contact's proposal for *quarterly* reports represents a major step backwards, would add unnecessary complexity and oversight duties to Commission staff, and would impose an unnecessary and undue burden on applicants.[60] The Commission has already eliminated the previous requirement under §25.210(j) of the Commission's rules to file *semi-annual* reports.[61] The current requirement of an annual report should meet the Commission's needs for regular reporting on the progress and operations of satellite systems.

D. Certification Of Milestone Requirements

The Commission seeks comments on its proposal to require operators to file affidavits certifying that milestone requirements have been met.[62] However, as is the case with the Commission's proposals regarding milestones and reporting requirements, the Commission's rules already include this requirement. Section 25.161(a) of the Commission's rules requires submission of a certification upon completion of milestone requirements, and licenses are automatically terminated upon failure to meet this

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59 *See* NPRM at ¶ 42.

60 *See Id.*

61 *See In the Matter of Streamlining of the Commission's Rules and Regulations for Satellite Applications and Licensing Procedures*, IB Docket No. 95-117, (released Dec. 16, 1996), at ¶ 14.

62 *See* NPRM at ¶ 42.

certification filing.[63] Thus, Hughes does not believe that there is any need for the Commission to consider the application of a new requirement, such as this, to the Ka-band NGSO FSS, because the existing requirement already applies.

IV. CONCLUSION

For the reasons set out above, Hughes proposes that the Commission adopt Option IV, Homogeneous Constellations, as the preferred spectrum-sharing scheme for all Ka-band NGSO FSS proponents. Unless Teledesic's recent system amendment is deemed a major modification and starts a third processing round, all proponents, including Teledesic, should share equally the burden of coordination, regardless of the option finally adopted. Finally, Hughes recommends that the Commission not adopt the proposed additional requirements concerning financial qualifications, milestones, or reporting requirements, because the Commission's current rules already are sufficient. If anything, the Commission should consider an alternative means for satisfying the financial qualification requirement which would more closely reflect current economic realities and the nature of the global satellite networks proposed in this proceeding.

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63 *See* 47 C.F.R. §25.161(a). This rule, like all other Part 25 rules, applies to all Ka-band licensees. *See* 47 C.F.R §25.145(a)

Respectfully submitted,

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Technical Annex

1.0 Introduction

In the latest FCC Ka band NGSO FSS NPRM five applicants out of six have proposed MEO constellations as their choice. Since most applicants are now proposing MEO constellations, the advantages of one homogeneous constellation versus independent constellations for different applicants was investigated from the frequency sharing and interference point-of-view. Homogeneous constellation here means that there is just one "orbital shell" having a number of planes and a number of satellites providing enough capacity/resources to support all the operators/organizations. The independent constellation means that systems are individually designed by each organization and operated independently of other constellations. With this in mind the objective of this analysis was to quantify the interference level at ground terminals when MEO systems are separately engineered by individual corporations in an un-coordinated fashion versus a single unified coordinated constellation in operation.

To satisfy the above objective the following test cases were simulated using "Visualyse" software.

Case 1: Independent constellations of Teledesic (30 satellites) and Hughes (20 satellites) with five terminals on the equatorial belt
Case 2: One harmonized constellation (Teledesic like) with 50 satellites (30 Teledesic + 20 Hughes) with 5 terminals on the equator
Case 3 Independent constellations of Teledesic (30 satellites), Hughes (20 satellites), and @ Contact (16 satellites) with five terminals on the equatorial belt
Case 4 One harmonized constellation (Teledesic like) with 65 satellites (30 Teledesic + 20 Hughes + 15 @ Contact) with 5 terminals on the equator

It should be noted that for the case of Teledesic, the system as proposed for modification by Teledesic on January 31, 2002, (i.e. the Teledesic MEO system) was used in this analysis. It should also be noted that @ Contact proposed a constellation consisting of 16 satellites which, when added to the other two constellations, would provide a total number of 66 satellites. However, in order to keep an equal number of satellites in all 5 planes it was decided to make the homogeneous case consist of 65 instead of 66 satellites.

The purpose of this analysis was not to propose a specific homogeneous constellation design, but rather to demonstrate the spectrum sharing advantages that could be realized should such an approach be adopted by the Commission. Hughes believes that the selection of a final set of homogeneous constellation parameters should be a matter of negotiation and agreement between and among U.S. NGSO FSS applicants

Section 2 provides detailed scenarios of simulation. Section 3 provides results of Hughes and Teledesic independent and homogeneous cases with terminals on the equator. Section 4 provides the results when all the three constellations are in place for both homogeneous and independent cases. Section 5 provides an overall conclusion based on Sections 3 and 4.

2.0 Scenarios

As stated in the introduction, the simulation examined interference in the downlink only with independent and homogeneous constellations with total numbers of 50 and 65 satellites. The simulation configuration is shown in **Figure 1(a)**, where a satellite terminal tracks a visible "Teledesic like" satellite and satellites belonging to Hughes and @ Contact act as interferers. The satellite selection criteria by a given ground terminal used in the simulation was the satellite with the highest elevation angle. The individual terminal was assumed to track the visible Teledesic like satellite at the highest elevation angle exceeding 40 degrees. The tracking continued so long as the satellite was visible and then handed over to the next highest visible Teledesic like satellite. A total of up to 10 and 15 links were assumed for each terminal for a constellation size of 50 satellites (Teledesic and Hughes together) and 65 satellites (Teledesic+Hughes+@ Contact together), respectively. Out of a total of 10 or 15 links the terminal captured the desired signal in one link and the other 9 or 14 links could have signals from the visible interferers. The assumption here is that not more than 10 and 15 satellites would ever be visible, respectively, in the two cases from a given terminal. If fewer than 9 or 14 satellites were visible from the earth station under examination, interference was aggregated from all visible satellites.

For each terminal the received signal power level from the desired satellite and the other interfering satellites (up to 9 or 14 in two cases) were collected along with the x, y, and z co-ordinates of the respective satellites at each time step. The time step value was 1 minute over a simulation interval of 6 hours, which corresponds to a single orbital period for a satellite in a constellation at an altitude of 10352 Km above the ground. Processing of raw data was carried out using Excel to arrive at the C/I vs. the angle between the highest interfering satellite and the tracking satellite. It should be noted that though the interference value was due to all satellites other than the desired one, the angle between the desired and interfering satellite is based on the dominant source of interfering satellite.

Orbit parameters for individual simulated constellations of Teledesic, Hughes and @ Contact along with a homogeneous Teledesic like constellation is shown in Table 1. The individual parameters are the same as stated in their respective FCC filings. The homogeneous constellation was "Teledesic like", as the number of planes, elevation angle requirements for tracking etc. were the same as the Teledesic filing except the orbit height was taken to be 10352 Km instead of 10900 Km for Teledesic. The orbital height of 10352 provides an orbit time of 6 hours, a sub-multiple of a sidereal day. For this study a six hour orbit was considered to be adequate as the conclusions drawn from this study will not change whether the orbit time is a sub-multiple of the earth's rotational period or not.

Figures 1(b) through **1(d)** are the antenna gain plots of Teledesic, Hughes, and @ Contact satellites. These plots are identical except the 3dB points are: 16.4, 19.3, and 19.2 degrees, respectively. These gain plots go down by 30 dB at $\approx 4^0$ away from the 3dB point. A steep fall in the gain curve is expected at the downlink operating frequency of 19 GHz. The terminal antenna gain curve is shown in **Figure 1(e)** where the 3dB beamwidth is 3.2^0. Beyond the 3dB point the gain curve follows the ITU recommended antenna pattern (APP 30 Earth Rx. Reg 1 & 3 Comm- selected within "Visualyse" software).

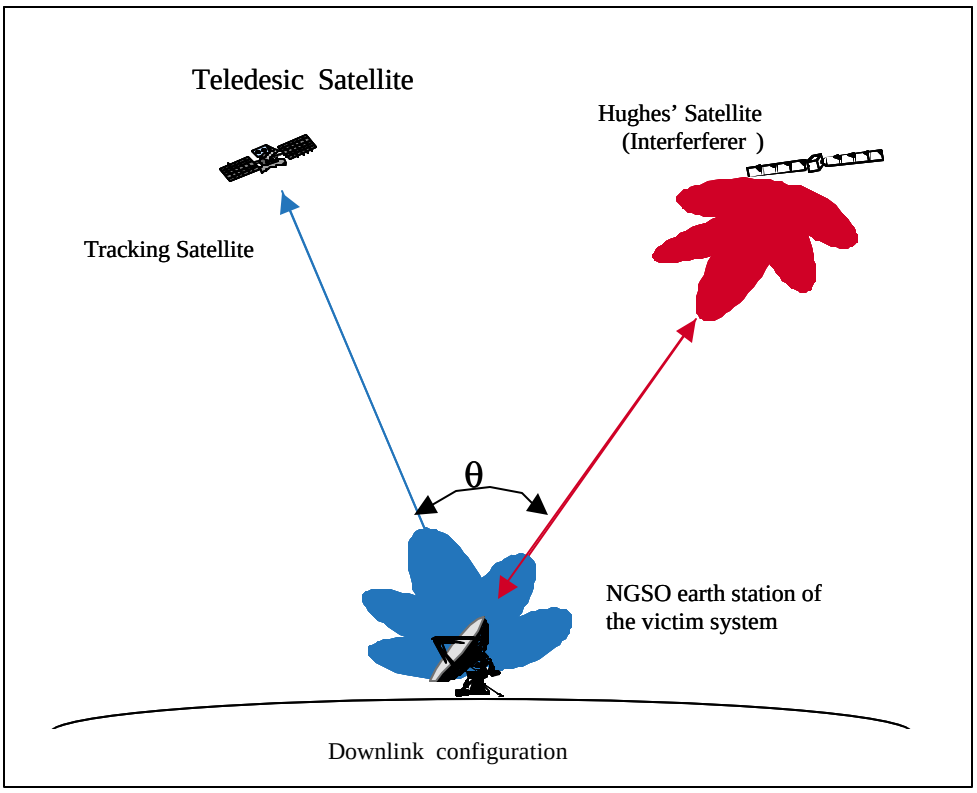

Figure 1A Interference Geometry

Satellite Constellation Parameters					
	Teledesic	Hughes MEO	@Contact	Harmonized Constellation (50 satellites)	Harmonized Constellation (65 satellites)
Orbital Height (km)	10,900	10,352	10,400	10,352	10,352
Number of Planes	5	4	4	5	5
Satellites per Plane	6	5	5	10	13
Total number of Satellites	30	20	20	50	65
Inclination Angle	46.7	55	45	46.7	46.7
Elevation Angle	40	30	30	40	40

Table 1 Orbit parameters for individual (Teledesic, Hughes, and @ contact) and Harmonized constellations

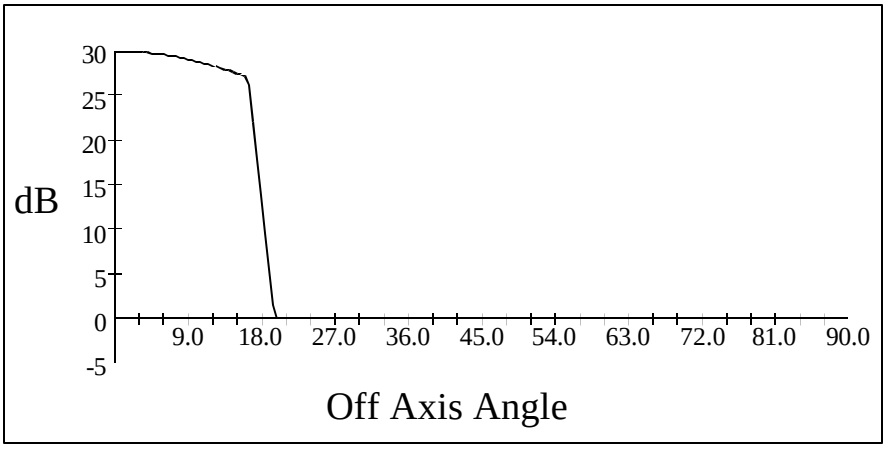

Figure 1(b) Antenna gain pattern for a Teledesic Satellite

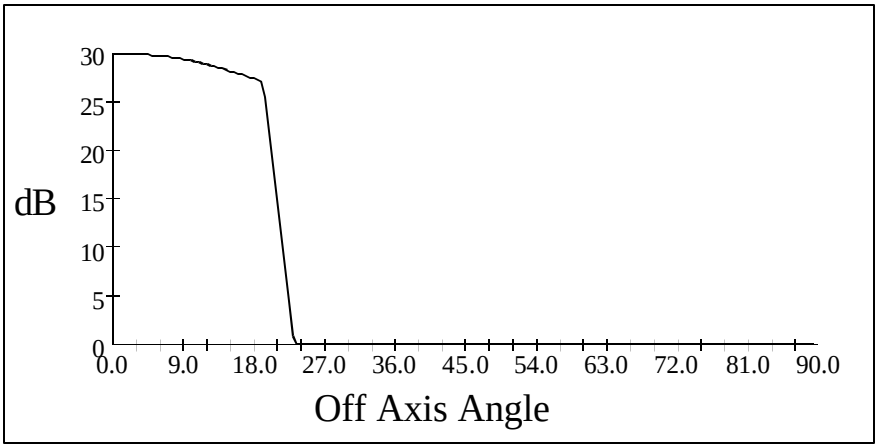

Figure 1(c) Antenna gain pattern for a Hughes Satellite

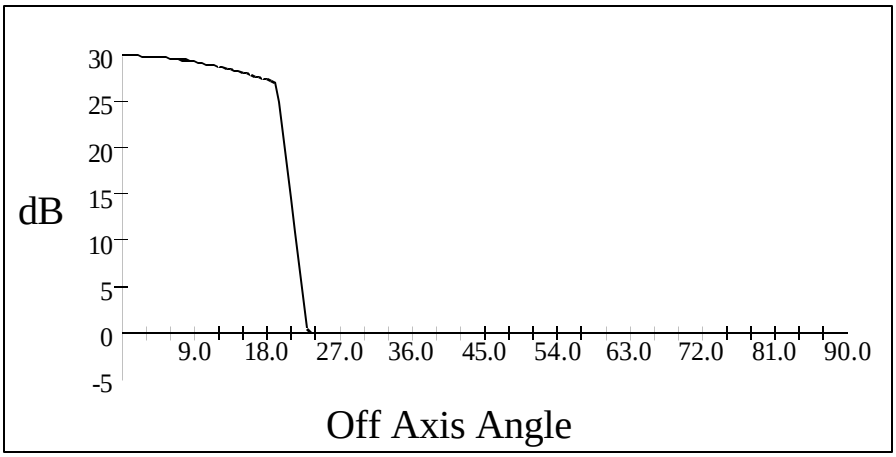

Figure (1d) Antenna gain pattern for a @Contact Satellite

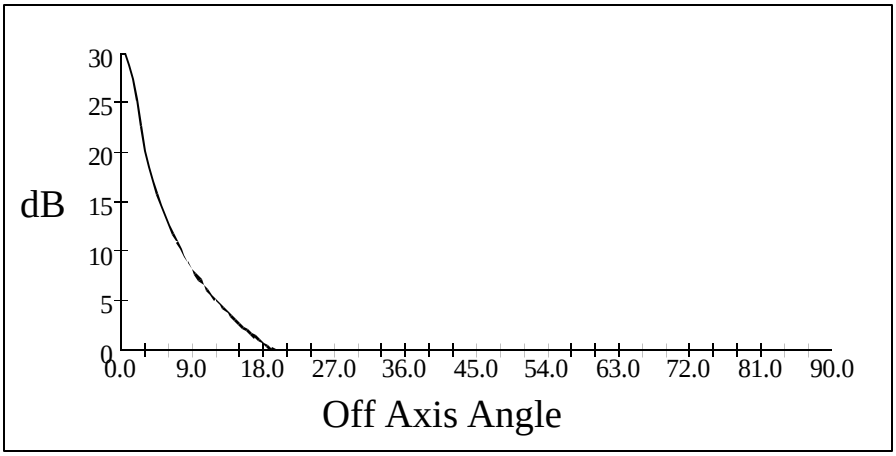

Figure (1e): Antenna gain pattern for a User Terminal

3.0 Results of Teledesic and Hughes

This section documents results of Teledesic and Hughes as independent and as homogeneous constellations. Note that for sake of simplicity, user terminals were assumed to be located along the equatorial belt.

3.1 User terminals at the equator

User placement on the equator is shown in Figure 2. The resulting C/I vs. time step for the independent case of Teledesic and Hughes is shown in Figure 3, with the aggregate C/I for each receive station shown plotted separately. The x-axis corresponds to the total interval of six hours while the y-axis plots the aggregate C/I. The threshold value of 10 dB was arbitrarily selected, for sake of discussion, to be the region of interest below which interference mitigation will be necessary. Four mitigation techniques have been suggested in the Ka band NPRM:

(a) Flexible Band Segmentation
(b) Dynamic Band Segmentation

(c) Avoidance of In-line Interference Events, and

(d) Homogeneous Constellation

All four of these techniques have been documented in the NPRM and thus it is not necessary to elaborate on these techniques here [1]. However, the motivation behind this study was the recommended technique (d) which leads to a lesser interference if all systems are of one type, namely, a homogeneous MEO constellation. Given that five out of six applicants are planning on using MEO constellations, there is support for investigation of this case. This study extends this case with further constraints of having a single homogeneous constellation which will be a common design agreed to by all parties.

The percentage of observations falling below the 10 dB C/I threshold criteria was 3.4%. A plot for the region where C/I ≤ 10 dB vs. the angle between the desired satellite and the satellite providing maximum interference is shown in Figure 4. In all cases this angle was $\leq 5^0$, which is consistent with studies performed by others and summarized in document ITU-R Working Party 4A TEMP81 [2].

Figure 5 shows the result of a homogeneous constellation. It is readily apparent that the C/I for this case is far more stable and fluctuates around a relatively high value of C/I. Comparison of Figure 3 with Figure 5 clearly shows a wide variance of C/I in the independent constellation case as compared with the homogeneous case. The wide variation of C/I can be attributed to the fact that at many time instants there are interfering satellites which come close to the desired satellite reducing the overall carrier-to-interference ratio of the terminal under observation.

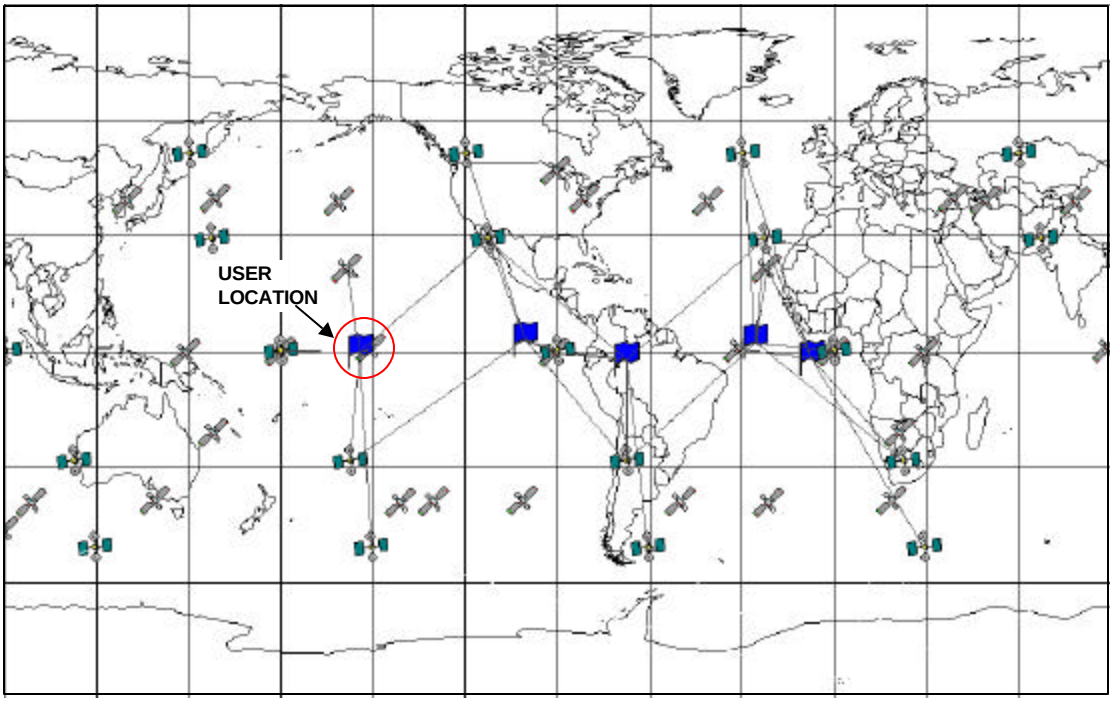

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Figure 2 User placement on Equatorial belt (Case 1)

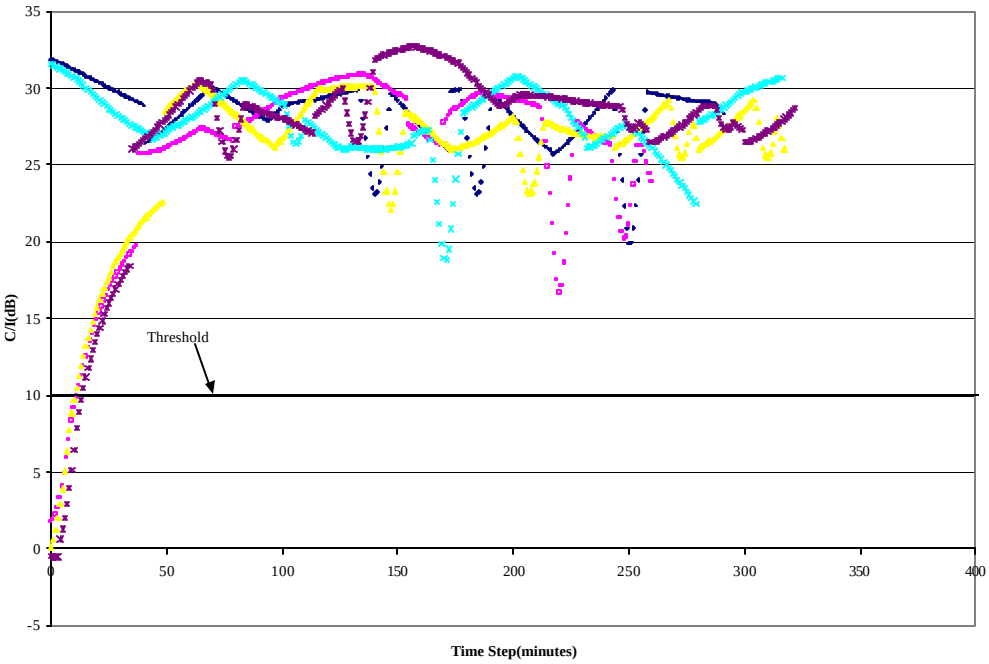


Figure 3: C/I vs. Time steps for users on the Equator (Case 1:Non-harmonized case)

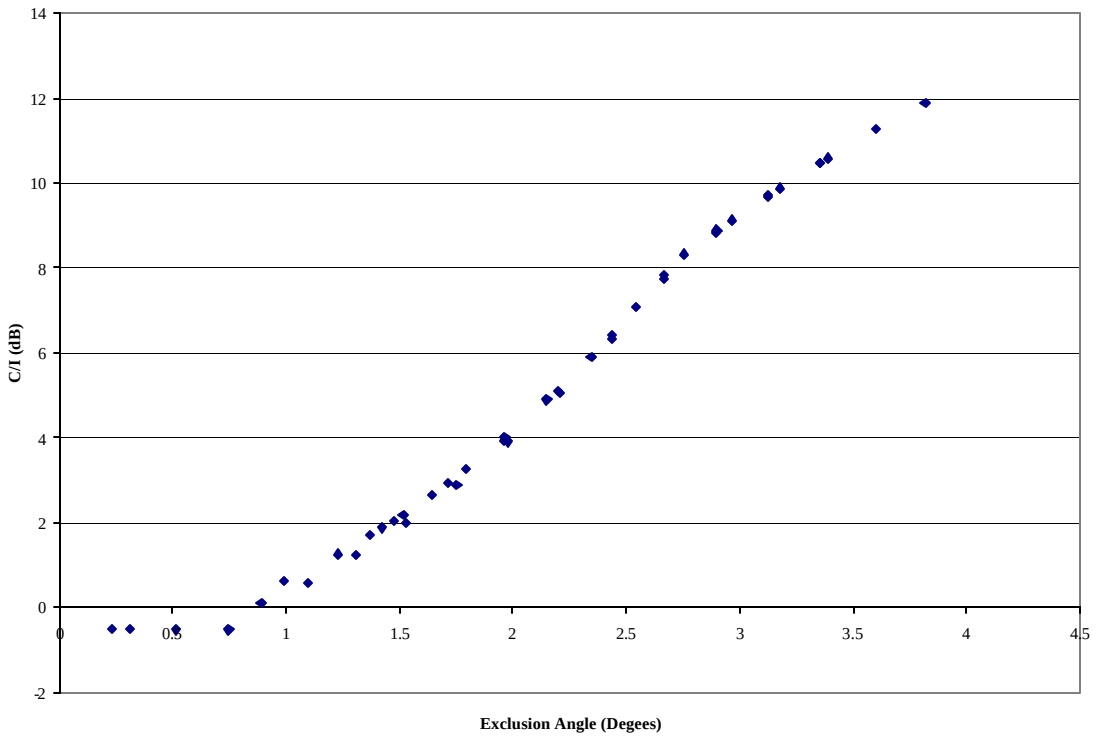


Figure 4: C/I vs. Exclusion Angle for users on the Equator (Case 1:Non-harmonized case)

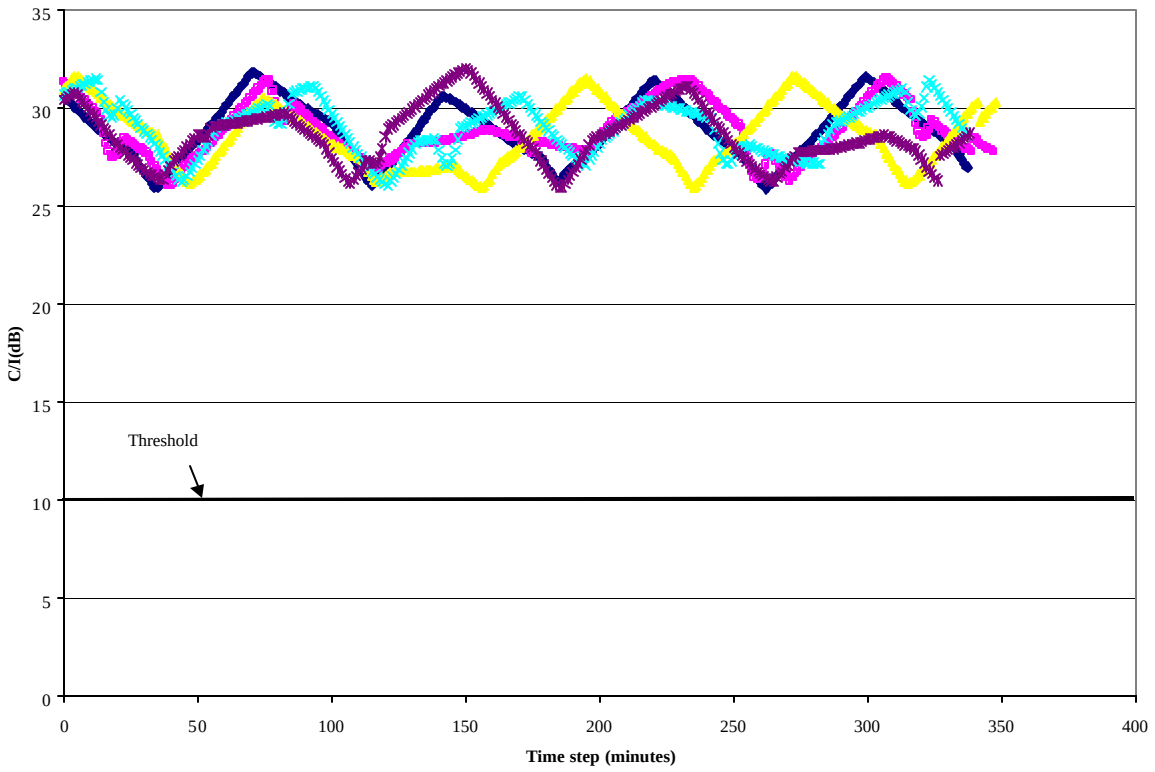


Figure 5: C/I vs. Time steps for users on the Equator (Case 2:Harmonized case)

4.0 Results of Teledesic, Hughes, and @ Contact

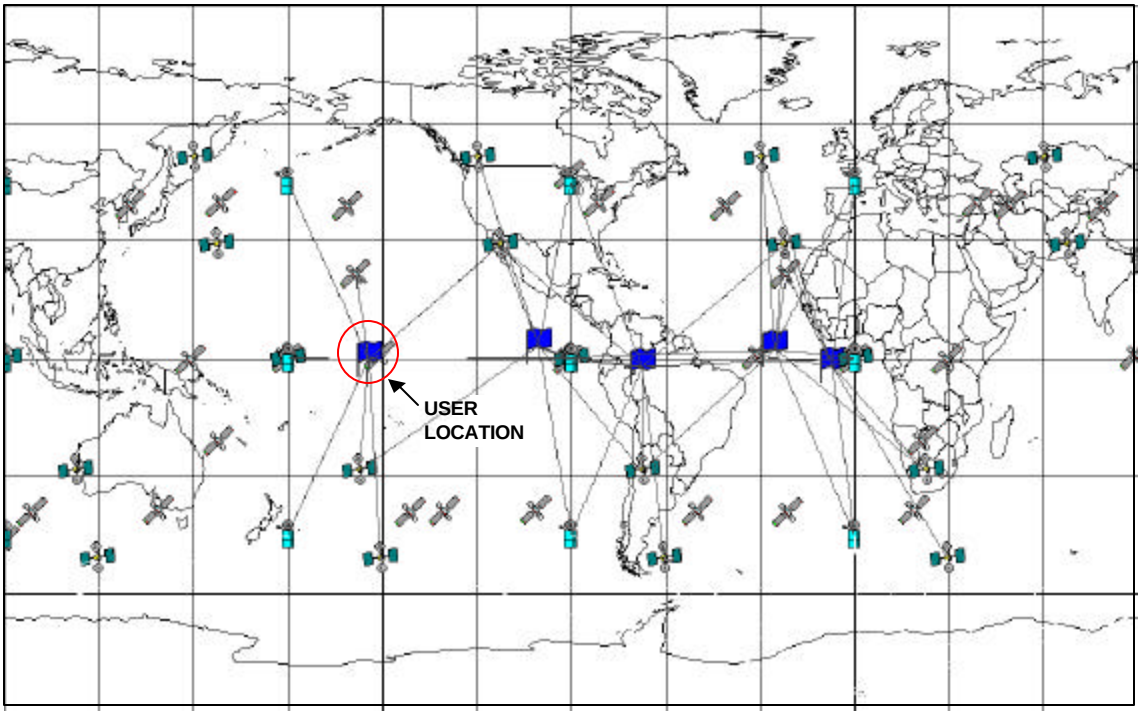
This section documents results of Teledesic, Hughes and @ Contact as independent and as homogeneous constellations. Similar to the case of Section 3, receive terminals were placed in the equatorial belt.

4.1 User terminals at the equator

User placement on the equator is shown in **Figure 6**. The resulting C/I vs. time step for the independent constellation case of Teledesic, Hughes and @ Contact is shown in **Figure 7**, with the aggregate C/I for each receive station shown plotted separately. The x-axis corresponds to the total interval of six hours while the y-axis plots the aggregate C/I. A threshold value of 10 dB was arbitrarily selected to be the region of interest where interference mitigation would be required. This Figure clearly shows a wide variance of C/I as expected due to an added @ Contact constellation.

The percentage of observations falling below a 10 dB C/I threshold criteria for this case was 7% , which is higher than the previous case discussed in Section 3. A plot for the region where C/I ≤ 10 dB vs. the angle between the desired satellite and the satellite providing maximum interference is shown in **Figure 8**. Once again, in all cases this angle was $\leq 5^0$, which is consistent with studies performed by others and summarized in document ITU-R Working Party 4A TEMP81 [2]. **Figure 9** shows the result for a homogeneous constellation. Comparing this result to that obtained for the case of 2 systems in a homogeneous constellation (Figure 5 Section 3) the variance has increased, as expected, due to the presence of the third @ Contact constellation, however the aggregate C/I is still quite settled. Comparison of **Figure 7** with **Figure 9** clearly shows a wide variance of C/I in the independent constellation case as compared with the homogeneous case. The wide variation of C/I can be attributed to the fact that at many

time instants there are interfering satellites, which come close to the desired satellite, reducing the overall carrier-to-interference ratio of the terminal under observation.



G-24446 P
04/02/02

Figure 6: Users placed on the Equator (Case 3)

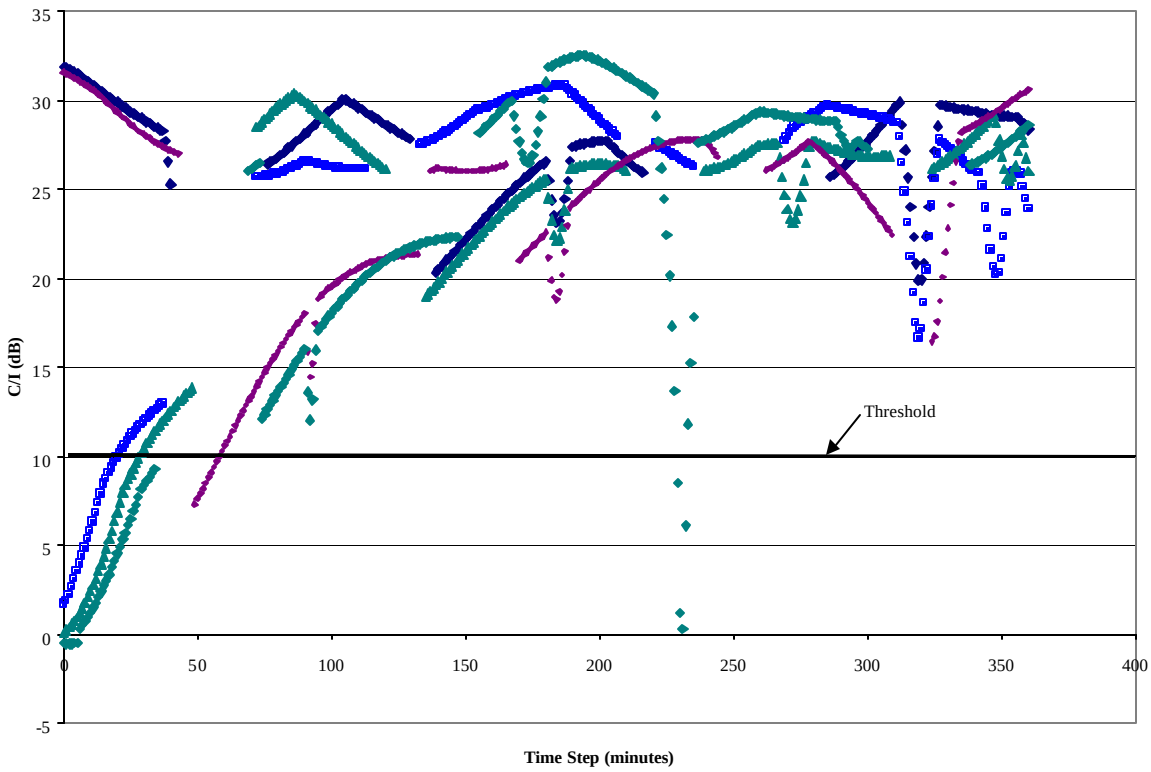


Figure 7: C/I vs. Time Steps for users on the Equator (Case 3:Non-harmonized case)

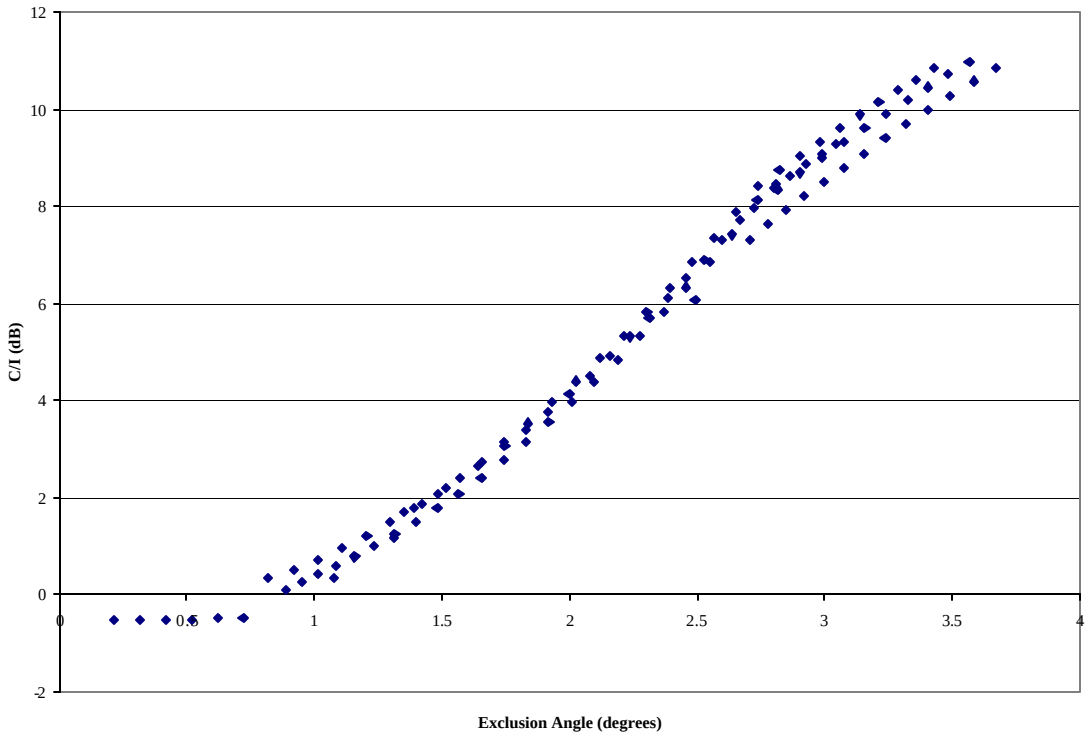


Figure 8: C/I vs. Exclusion Angle for users on the Equator (Case 3:Non-harmonized case)

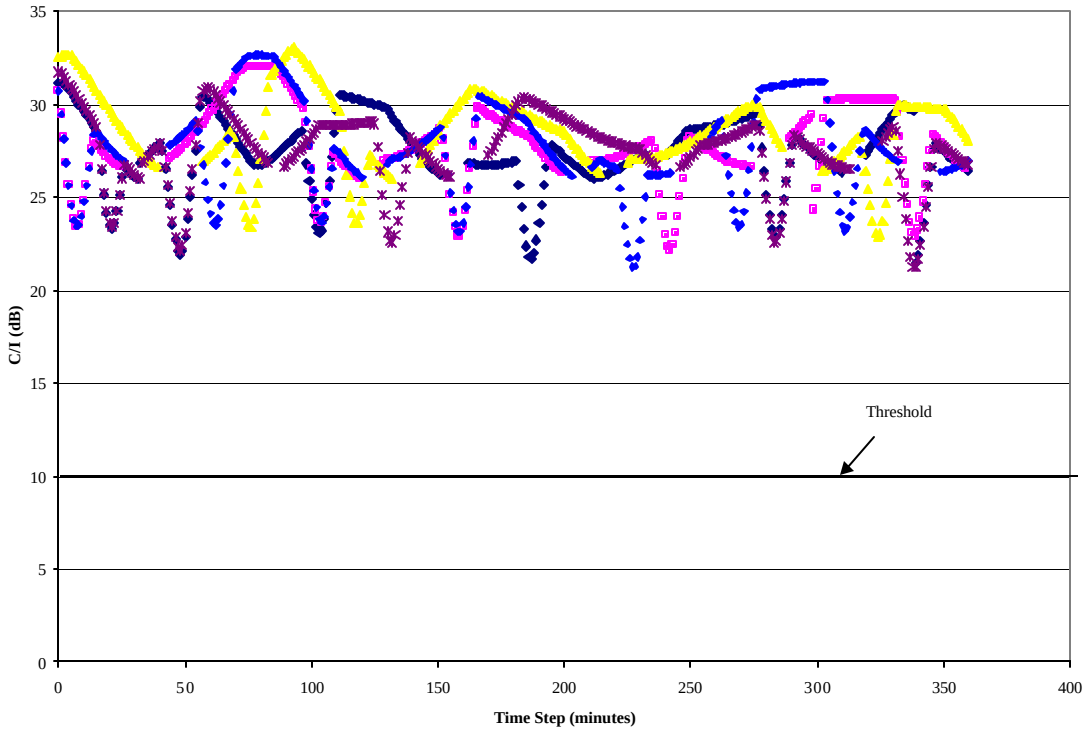


Figure 9: C/I vs. Exclusion Angle for users on the Equator (Case 4:Harmonized case)

5.0 Conclusions

The following conclusions can be drawn based on the results of this study documented in Sections 3 and 4.

- Consistently lower values of C/I (i.e. highere values of interference) result for the independent constellation cases as compared to the homogeneous case.
- C/I values remain relatively high over time for homogenous constellations with 50 and 65 satellites
- Variance of C/I increases as the number of constellations increase or the number of satellites increase in the homogeneous case, however for he cases studied the variance over time was still quite acceptable
- The average value of C/I drops down by ≈1.8 dB for the homogeneous case when the constellation size changes from 50 satellites (Teledesic + Hughes) to 65 satellites (Teledesic + Hughes + @ Contact)

a. References

[1] FCC, "Notice of Proposed Rulemaking- In the matter of the Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ka-band", February 6th 2002.

[2] ITU Working Party 4A, "Frequency Sharing between Non-GSO FSS Systems in bands below 30 GHz", Document 4A/TEMP/81-E, 28th April 2001.

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in the foregoing Comments of Hughes Communications, Inc., 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 pleading, and that it is complete and accurate to the best of my knowledge and belief.

Leonard S. Golding

Leonard S. Golding
Vice President
Hughes Network Systems

April 2, 2002