B. S-Band Sharing

The comments filed in this proceeding indicate a surprising degree of confusion concerning the requirements of ITU Footnote No. 753X with respect to power flux density limitations in the S-band. For example, Constellation states that "[t]he Commission's position in paragraph 24 of the Notice is confusing because it both 'requires' LEO systems to conform to this PFD limit and recognizes the need for coordination if the PFD limit is exceeded." See Comments of Constellation at 7. Seizing an opportunity to divide and conquer, AMSC states categorically that the Commission "has proposed treating the international PFD threshold as an absolute limit for domestic MSS systems." See Comments of AMSC at 14.

In TRW's view, there is no ambiguity in the Commission's proposal. AMSC's interpretation of the PFD limits in these bands is clearly erroneous. The Commission made explicit in the Notice and Tentative Decision that it was proposing "the power flux density limits adopted at WARC-92." 7 FCC Rcd at 6417. The changes in the ITU regulations made at WARC-92 were designed to facilitate the use of these bands by non-geostationary systems, not to impede such use.

Thus, the only permissible interpretation of this proposal is that Footnote 753X mandates that the power flux density limits specified in Radio Regulation No. 2566 serve as a trigger for coordination under Resolution COM5/8. TRW supports

this proposal. See TRW Comments at 20-21. AMSC's call for disparate treatment of non-geostationary and geostationary systems for PFD limit purposes (or, for that matter, for EIRP density limit purposes) is totally baseless and must be rejected out of hand. See Technical Appendix hereto at A-4.

AMSC and CELSAT also erroneously contend that the PFD limits should be applied on a cumulative basis, such that each system would be allotted only a portion of the "total flux density." See AMSC Comments, Technical Appendix at 8; CELSAT Comments at 9. Based on this error, AMSC then claims that such a limit would reduce the capacity of each of the spread spectrum systems to, at best, "a few channels." AMSC Comments Technical Appendix at 8. As explained in more detail in the Technical Appendix hereto, it is premature to attempt to quantify in definitive terms what such limits will be. See Technical Appendix at A-6 to A-8. Many parameters used in analyses at this stage are mere assumptions, and a change in even one or two assumptions can have a dramatic impact on the overall result. By arbitrarily making worst- or best-case assumptions, anyone can manipulate the conclusion. Because these issues are so complex and inter-related, not to mention speculative, no definite conclusions can be reached at this stage. TRW believes these matters would be more appropriately dealt with as part of the negotiated rulemaking proceeding, or even at a later date (i.e., during inter-system coordination).

IV. THE HANDSETS USED WITH NON-GEOSTATIONARY MSS SYSTEMS SHOULD NOT POSE ANY THREAT OF HUMAN EXPOSURE TO HAZARDOUS LEVELS OF RADIOFREQUENCY RADIATION.

Most parties agree that MSS handsets designed for non-geostationary systems are, or can be made, fully compliant with radiofrequency exposure standards. See, e.g., Comments of LQSS at 21.[11/] Although there may not yet be a consensus on what the Commission's role in the standard-setting process should be, there seems to be general agreement that the relatively low-power handsets proposed by the non-geostationary systems for 1610-1626.5 MHz band uplinks will not pose an unacceptable health risk. In any event, the applicants are committed to assuring the safety of MSS system handsets to the users of their systems. See, e.g., TRW Comments at 29; Motorola Comments at 22.

11/ The only party to express real concern about RF radiation was AMSC. See AMSC Comments at 21. Upon close scrutiny, however, it appears that AMSC's own technical consultant limits his concern to cases where antenna input power of the handsets exceeds 600 milliwatts, and the hazard even then is only "potential." See AMSC Comments, Technical Appendix at 13.

V. THE COMMISSION'S REJECTION OF MOTOROLA'S PIONEER'S PREFERENCE REQUEST WAS BOTH NECESSARY AND PROPER.

A. Motorola's Exclusive, Sole-Provider System Cannot Lawfully Be Granted A Preference Over Other Mutually-Exclusive Applicants.

As TRW has demonstrated on several occasions in this and other proceedings, there are substantial questions outstanding as to the lawfulness of the Commission's pioneer's preference procedure in those instances where parties requesting pioneer's preferences also have mutually exclusive applications pending. See, e.g., TRW's Opposition to Pioneer's Preference Request of Motorola Satellite Communications, Inc., ET Docket 92-28 (filed April 8, 1992) at 17-21; TRW's Motion for Stay, ET Docket 92-28 (filed May 5, 1992). In short, because implementation of Motorola's system proposal would effectively preclude the proposals advanced by the other applicants, and vice versa, any license guarantee to any of the RDSS-band applicants in the form of a pioneer's preference would have been tantamount to denial of at least one of the other mutually exclusive applications without benefit of the statutorily required hearing. See 47 U.S.C. § 309(e); Ashbacker Radio Corp. v. FCC, 326 U.S. 327 (1945) ("Ashbacker"). Thus, the Commission's tentative decision to deny all of the requests was appropriate.

Even if Motorola is correct in its assertion that the Commission's impanelling of outside experts to review the pioneer's preference requests was unlawful (see Motorola Comments

at 23), no purpose would now be served by making the experts' reports available for comment. As described above, the Commission cannot grant the request of any pioneer's preference requestor without violating the "Ashbacker" rights of at least one other applicant. In tacit recognition of this fact, each of the eligible applicants denied a preference in the Notice and Tentative Decision -- with the sole exception of Motorola -- has acquiesced to the Commission's determination in the interest of expediting inauguration of the service.[12/]

B. Motorola Has Not Demonstrated Its Entitlement To A Pioneer's Preference.

Even if an award of a pioneer's preference to Motorola were not statutorily infirm, Motorola is not entitled to a preference for its Iridium proposal under the criteria established by the Commission. The Commission made clear in its order adopting the pioneer's preference that it intended such preferences to reward parties that have "brought out the capabilities or possibilities of [a] technology or service or . . . brought them to a more advanced or effective state." See

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12/ Most of the parties acquiescing to the denial of a preference request, including TRW, have conditioned their acceptance of the decision upon the other parties also agreeing not to contest the Commission's determination. See, e.g., Constellation Comments at 2 n.3. In the expectation that the Commission will act rationally by denying Motorola's attempt to undercut the Tentative Decision, TRW will decline this opportunity to address the conditional protests to the Commission's action of the other preference requestors.

Establishment of Procedures to Provide a Preference to Applicants Proposing an Allocation for New Services, 6 FCC Rcd 3488, 3494 (1991) ("Pioneer's Preference Order"). As the Commission correctly concluded in the Notice and Tentative Decision, "the Motorola approach does not offer a significant improvement or innovation over the state of the art." 7 FCC Rcd at 6421. Rather, Motorola has simply utilized several existing technologies, developed and advanced by others, and combined them into a rather complicated and fantastic scheme.[13/]

In the face of objections raised by other applicants and, now, the tentative conclusion reached by the Commission itself, Motorola has raised only the vague and circular argument that it is entitled to a pioneer's preference because it has incorporated different technologies into an "overall service concept" -- as if having an idea that is simply different from everyone else is sufficient to make one a pioneer. See Motorola Comments at 26. Contrary to Motorola's claim, the uniqueness of system concept is not the test for entitlement to a pioneer's preference. If it were, virtually any applicant could receive a

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13/ Moreover, to the extent that Motorola meets any of the specific examples of characteristics probative of entitlement to a preference, characteristics that are possessed by other applicants as well, Iridium's inability to share spectrum with other providers undermines these seeming advantages. Indeed, grant of a pioneer's preference to Iridium would have violated the policies behind both the pioneer's preference and the original RDSS allocation, which required pro-competitive spectrum sharing technology.

preference on the basis of a proposal that differed from others in key respects.

Indeed, Iridium's heavy reliance on the "uniqueness" of its "service concept" as a justification for a preference is indicative of the baselessness of its claim of entitlement to a preference over the other applicants. The one sense in which Motorola is an innovator is that in which all of the LEO MSS pioneer's preference applicants are innovators -- each has formulated its own approach to providing MSS and RDSS service via non-geostationary satellites in the L- and S-Band frequencies originally allotted to RDSS.[14/] If Motorola were entitled to a preference on the ground claimed, such a "preference" would be a nullity, as all other applicants would be entitled to the same treatment.

Equally irrelevant is Motorola's claim to have been the "originator" of the LEO satellite "service concept."[15/] Whether

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14/ To the extent that Motorola relies on its August 10, 1992 Amendment to its Iridium application to buttress its pioneer's preference request, such reliance is misplaced. At best, the final date for submission of new material pertaining to the preference request was four months earlier, April 10, 1992, the date upon which Motorola previously "supplemented" its preference request. Motorola clearly may not rely on information submitted after this cut-off date.

15/ In fact, as TRW has previously observed, Globesat Express proposed low-Earth orbit satellite technology in one of the original applications for the generic MSS service. See TRW Opposition to Motorola Pioneer's Preference Request at 12 n.7 (citing Application of Globesat Express, GEN Docket No. 84-1234 (filed April 30, 1985) at 2).

or not it was the first to begin work on such a system, and regardless of the time and money it claims to have invested, the fact remains that four other very different proposals for implementing an MSS/RDSS service were offered to the Commission at virtually the same time, at least one by a company -- TRW -- that has actually been a force in developing the technologies utilized. Time and money spent are not, by themselves, probative of innovativeness. Rather, as is clear from the Commission's Pioneer's Preference Order, the central question is whether the applicant has been the originator of a technological development that makes a new service possible.

When evaluated pursuant to that standard, it is apparent that Motorola's Iridium proposal is based entirely on technologies that were originally developed by others (including TRW). See TRW Opposition to Motorola Pioneer's Preference Request at 11-12. Consequently, Motorola can provide no example of a technology or feature that it either developed or enhanced for inclusion in its Iridium system -- it simply has not originated any single idea that makes its system possible.[16/]

Finally, Motorola has failed even to demonstrate that its hodgepodge of borrowed technologies is feasible as an "overall service concept." The fact that individual technical

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16/ Ironically, while Motorola compares itself to pioneer's preference recipient VITA, and is able to cite a specific innovation credited to VITA, it fails to name any development for which it is itself responsible. See Comments of Motorola at 31.

advances incorporated in Iridium have been demonstrated by others does not mean that they can successfully co-exist in the complex arrangement proposed by Motorola. Motorola clearly is not entitled to a pioneer's preference of any kind.

VI. CONCLUSION

For the reasons set forth herein, the Commission should proceed to allocate the 1610-1626.5 MHz and 2483.5-2500 MHz bands for the implementation of LEO MSS systems on a competitive multiple entry basis, as proposed in the Notice and Tentative Decision. At the same time, the Commission should reject the repetitious and unfounded arguments raised by Motorola and affirm its tentative decision to award no pioneer's preference in this proceeding. These decisions will open the way for expeditious consideration of system rules and standards through the just-commenced negotiated rulemaking process in CC Docket No. 92-166.

Respectfully submitted,

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Technical Appendix

Technical Appendix

Contents **Page**

1. Introduction A-2

2. Coordination with Other Non-MSS Users of the Band A-2

   2.1 Coordination with Glonass A-2

   2.2 Coordination with Radio Astronomy Service (RAS) A-3

   2.3 Coordination with Fixed Services A-4

3. Sharing with Other MSS Users of the Band A-4

   3.1 Motorola's "Ghost" A-5

   3.2 The Essential Difference between Systems that Propose Multiple Access to the Same Frequency Spectrum and Those that Require Dedicated Spectrum A-5

   3.3 The Homogeneity of the Various Systems A-5

   3.4 Capacity Limitations related to Downlink PFD A-6

   3.5 Sharing with Geostationary Satellite Systems A-8

4. Spectral Efficiency A-8

5. Operational Flexibility of Spread Spectrum A-9

1. Introduction

This Appendix addresses technical issues raised during the first round of comments regarding the Commission's Notice of Rule Making and Tentative Decision in ET Docket No. 92-28, which proposes to allocate the 1610-1626.5 MHz and 2483.5-2500 MHz bands for use by geostationary and non-geostationary Mobile Satellite Service (MSS) systems.

2. Coordination with Other Non-MSS Users of the Band

2.1 Coordination with Glonass

Footnote 731X of the Radio Regulations is intended to ensure that MSS transmissions do not cause unacceptable interference to the Russian Glonass system. This footnote was added during WARC 92, with active participation of the Russian delegation. According to this footnote it is necessary for the e.i.r.p. spectral density of MSS uplink transmissions to be no greater than -15 dBW/4kHz in parts of the band that Glonass is occupying to avoid the necessity for coordination. Because of the use of spread-spectrum access techniques, the ODYSSEY uplink transmissions will be fully compliant with this requirement, even using the highest powered ODYSSEY mobile terminals.

Counter to the information given in footnote 731X of the Radio Regulations, AMSC[1] has performed an analysis of potential interference from MSS uplinks into the Glonass system, and concluded that a very large "blackout" area (68,000 square miles) would be required to protect Glonass. Separately, Celsat[2] has performed yet another analysis, using different parameters for both the Glonass system and the propagation model, which produces quite different conclusions about the size of the required blackout area. In addition, Comsat[3] is planning to perform actual measurements using Glonass equipment to determine, with more accuracy, the protection requirements of the Glonass service, with results likely to be available in the first quarter of 1993.

In the light of all the above uncertainties and conflicting information, the most sensible course of action is to assume the

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1 See Comments of AMSC Subsidiary Corporation, ET Docket No. 92-28 (December 4, 1992)

2 See Comments of Celsat, Inc., ET Docket No. 92-28 (December 2, 1992)

3 See Comments of Communications Satellite Corporation, ET Docket No. 92-28 (December 4, 1992)

protection parameters provided by the operators of the Glonass system, which are embodied in the international Radio Regulations. This position can be modified if necessary when the Comsat experiments produce conclusive evidence concerning the actual interference susceptibility of Glonass.

Although the spread spectrum ODYSSEY system is able to comply with the Glonass protection requirements as they are understood at present, the same is not true for the Motorola Iridium system or the AMSC system (insofar as the latter has been defined). Indeed, it has not even been demonstrated that the AMSC system can comply with the higher -3 dBW/4kHz limit for parts of the band that are not shared with Glonass.

With the advent of Glonass-M, as advanced published in early 1992 prior to WARC 92, the frequency ranges occupied by Glonass in areas outside of the USA, will extend up to 1621.1 MHz. Although this would have a lesser effect on AMSC because of its emphasis on domestic US operation, the impact on the worldwide aspirations of the Motorola Iridium system will be very significant. Iridium would be constrained, in areas outside of the USA, to operate only at frequencies above 1621.1 MHz, thereby severely reducing the capacity of the system.

2.2 Coordination with Radio Astronomy Service (RAS)

TRW notes the comments made by the National Academy of Sciences (NAS) regarding ways to ensure that unacceptable interference is not caused to the Radio Astronomy Service operating in the 1610.6-1613.8 MHz and 4990-5000 MHz bands.

In the case of the ODYSSEY system, which uses only the primary frequency allocation in the 1610.6-1613.8 MHz band, the potential interference will be limited to that caused by mobile terminal transmissions.[4] The use of "exclusion zones" around the RAS sites using this frequency range, as proposed by NAS, would be an effective way to prevent this interference. The use of a wide spreading bandwidth for the ODYSSEY transmissions will minimize the potential interference-causing effect of these transmissions and thereby reduce the required size of these exclusion zones. The use of beacon transmissions from the RAS sites to identify the exclusion zones, as cited by NAS, appears to be an effective implementation technique. TRW will work with NAS to determine the

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[4] Unlike the ODYSSEY system, Motorola's Iridium system proposes using the adjacent frequency range for satellite-to-Earth downlink transmissions, thus causing a very serious interference threat to the RAS service.

appropriate technical parameters and plan for the implementation of such a system.

Regarding NAS's concerns about harmonics of the satellite transmissions in the 2483.5-2500 MHz band falling in the RAS band from 4990-5000 MHz, TRW will again work with NAS to ensure that this does not become a problem by appropriate output filtering in the satellites. The specification and control of this parameter, and that of spurious transmissions in general, is normally made taking into account the needs of the RAS.

2.3 Coordination with Fixed Services

The proposals made by AMSC regarding the use of the PFD trigger levels (which are defined in the Radio Regulations) as absolute limits for non-geostationary MSS systems, are totally inappropriate to the ODYSSEY system. The computer simulation of the interference from ODYSSEY into terrestrial radio links (Fixed Services), performed by AMSC, is erroneous in that it does not take account of the fact that the ODYSSEY satellites are only active during part of their orbit arc, and therefore will not be radiating into the main beams of terrestrial radio links as the ODYSSEY satellites cross the horizon. This incorrect assumption made by AMSC makes the results of their simulation meaningless.

In addition, not only is AMSC's call for different standards for geostationary and non-geostationary MSS systems completely contrary to the language and intent of the WARC '92 Final Acts, geostationary systems such as AMSC's are more likely to cause interference to terrestrial links than TRW's ODYSSEY system is. In practice, the ODYSSEY satellites will be operating at significantly higher elevation angles over large areas of North America than would be possible for a geostationary satellite such as AMSC. This will result in considerably less likelihood of interference to terrestrial radio links from ODYSSEY than would be caused by AMSC. It is therefore highly unlikely that there will be a coordination problem between the ODYSSEY system and the Fixed Services.

3. Sharing with Other MSS Users of the Band

The ability to share the available spectrum between the various domestic and foreign MSS operators is a key concern, and one that has been addressed by several of the applicants in their Comments. This section responds to some of the points raised concerning this subject.

3.1 Motorola's "Ghost"

The "ghost" of "CDMA limitless spectrum sharing" seems to be something created only by the imagination of Motorola[5], yet something which they have chosen to discuss at great length in their Comments. Certainly, TRW has never claimed that CDMA overcomes the basic limit on the capacity of the spectrum, as inferred by Motorola. The mere suggestion that this might be the case would lead one to question whether Motorola truly understands the way in which CDMA systems operate. Rather, the motivation to use a spread-spectrum access technique is to exploit its unique capability to permit multiple system access to the same frequency band, thereby fulfilling the fundamental requirement of the FCC to provide multiple entry and hence to foster competition.

3.2 The Essential Difference between Systems that Propose Multiple Access to the Same Frequency Spectrum and Those that Require Dedicated Spectrum

Both Motorola and AMSC attempt to confuse the distinction between those systems that propose multiple access to the same frequency spectrum and those that require dedicated spectrum. The former are generally referred to as "the CDMA systems". Although they may make use of FDMA in addition to CDMA, this is irrelevant in the context of their assessment as candidate access schemes for the subject MSS frequency band. The important characteristic of the CDMA systems is that they are designed to tolerate interfering signals within their own operating bandwidth, which enables them to be used in a regulatory environment that permits multiple entry to the spectrum resource. They are fundamentally distinguished from the latter access schemes (TDMA/FDMA) which require their own dedicated piece of spectrum in which to operate, which leads to a situation of "spectrum grabbing" which is impossible to regulate in an equitable way.

3.3 The Homogeneity of the Various Systems

The "homogeneity" referred to by Motorola, which they admit will enhance the ability of spread-spectrum systems to efficiently share the spectrum, needs to be carefully considered. As pointed out by Celsat, it is the characteristics of the Time-Division Duplexed system proposed by Motorola that creates inhomogeneity between the applicants. The Motorola system is fundamentally

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5 See Comments of Motorola Satellite Communications, Inc., ET Docket No. 92-28 (December 4, 1992)

incapable of sharing spectrum with any other similar or different systems. By contrast, the relevant characteristics which should be homogenized between the various spread spectrum systems in order for efficient spectrum sharing to occur relate primarily to the antenna gain and power characteristics of the mobile terminals, and not to the satellite orbits or other extraneous system characteristics. This view is supported also by AMSC and Celsat. One of the key advantages of the use of the subject spectrum for non-geostationary mobile satellite communications is its ability to offer voice communications to hand-held telephones. It is therefore reasonable to assume that all the applicants (with perhaps the exception of AMSC due to fundamental limitations in its first generation system) are driven by the needs of the market, and will therefore offer a service to this type of terminal. The effect of this market pressure for a convenient telephone service will inevitable lead to homogenization of the systems insofar as the characteristics of the mobile terminals are concerned. The Motorola assertion that "such homogeneity would require an unprecedented degree of technical standardization between the applicants" is therefore unwarranted and should be ignored.

3.4 Capacity Limitations related to Downlink PFD

It is well understood that, in the case of the CDMA systems, the downlink PFD generated by each system will be a measure of the amount of the spectrum resource used by that system. It is also clear that there is an upper bound to the total PFD available as, when the systems become severely interference limited, the trade off between additional capacity and extra link power required is characterized by the law of diminishing returns.

Celsat has performed a simple calculation in an attempt to determine the optimum total PFD figure, from the spectrum sharing point of view. Whilst the general principle of this approach is sound, TRW believes it to be overly simplistic, and therefore too conservative. It should be noted that a 3 dB error in the determination of this proposed limit would half or double the capacity of the spectrum (depending on the sign of the error). We would therefore caution any proposal to impose a limit derived in this way. The value in performing the analysis is rather to gain a general feel for the numbers and the principles at stake, rather than to determine a hard overall limit. We would agree with the Celsat conclusion that this is a complex issue, and one that is best dealt with during the negotiated rule making, or even at a later date during inter-system coordination between the MSS systems.

The results of the AMSC analysis which "demonstrates" that the ODYSSEY system would not be able to operate with multiple CDMA

systems in operation are completely erroneous. This analysis is based on the principle that there would be four other systems, each generating a PFD of -142 dBW/m^2/4kHz, which is the trigger level for coordination with the Fixed Services. The errors in the analysis are detailed below:

(a) The derivation of the interfering signal power density ("I_o") is incorrect. With the assumption of a mobile terminal antenna gain of + 3 dBi (which in itself is not a valid assumption as explained below), the conversion from the PFD (four systems at -142 dBW/m^2/4kHz) should produce an I_o of -198.4 dBW/Hz, not -194 dBW/Hz as given by AMSC. This amounts to an error of 4.4 dB.

(b) The maximum EIRP per beam for the ODYSSEY satellite is assumed by AMSC to be 24.3 dBW (see AMSC Table 3). The correct figure, as provided in the TRW ODYSSEY FCC filing[6], is 44 dBW. This derives from an SSPA power of 36 Watts feeding an antenna with a gain of +28.4 dBi. The error made by AMSC in this case is almost 20 dB.

(c) The Required Signal Power assumed by AMSC (see AMSC Table 3) is more than 12 dB higher than the correct figure. This is a further significant error.

In addition to the above numerical errors, which amount to more than 36 dB in total (or more than 4000 times) the AMSC analysis is also unrealistic for the following reasons:

(d) It is unlikely that all the current applicants will reach the implementation stage of their proposed systems. A realistic assessment would suggest that no more than two or three are likely to reach full system deployment. This would mean a lower level of interfering PFD, by as much as 3 dB.

(e) Even if all the applicants implemented their proposed systems, at least two of those systems are incapable of producing as high a PFD as -142 dBW/m^2/4kHz due to limitations in spacecraft power.

(f) The assumption that the receiving mobile terminal has an antenna gain as high as +3 dBi towards all interfering satellites simultaneously is very unlikely. A lower average figure should be factored into this calculation.

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6 See Application of TRW Inc., (May 31, 1991)

In conclusion, the results of the AMSC analysis which address the likely limitations in capacity of the CDMA systems, are so erroneous as to be meaningless, and should therefore be ignored.

3.5 Sharing with Geostationary Satellite Systems

Although in principle, from a technical point of view, geostationary and non-geostationary MSS systems can share the same frequency band, this will only work effectively when both types of satellites have the same size antenna beam footprints. This view is supported also by AMSC and Celsat. With the first generation AMSC system, the satellite antennas are simply not large enough to produce beams on the earth as small as those produced by the non-geostationary satellites. The effect of this disparity is that the geostationary system will require greater e.i.r.p. from its mobile terminals which will have a greater interfering effect into the non-geostationary satellites. It would therefore be appropriate to consider sharing the subject band only with second generation geostationary satellites which will have adequately sized antennas. This would also allow experience to be gained in the development of the geostationary system to determine if and when it might require additional bandwidth.

4. Spectral Efficiency

Regarding Motorola's claims about the "spectral efficiency" of the proposed Iridium system, the following comments should be considered:

(a) Motorola claims that its bidirectional use of the frequency band is an asset in terms of spectral efficiency. In reality the opposite is true. The Time-Division Duplex (TDD) operation of the proposed Iridium system is wasteful on spectrum because: (i) it leaves the paired S-band unused; and (ii) it requires excessive time guard bands between receive and transmit time slots to (attempt to) overcome the (near impossible) synchronization problems.

(b) In a multiple beam system design (whether it be terrestrial cellular or MSS) the spectral efficiency can be greatly improved if frequencies can be reused in adjacent beams or cells. Only CDMA systems have the inherent capability to achieve this, whereas a "dedicated spectrum" transmission scheme (e.g., FDMA or TDMA) would only be able to reuse frequencies at best in alternate beams or cells. In making the simplistic claim about

"spectral efficiency" Motorola is not taking into account factors such as these.

(c) Although "spectral efficiency" is of crucial importance in designing (and licensing) any communications system, it is not the "be all and end all" by itself. For example, it is possible to trade link power against modulation scheme in any communications system, and to demonstrate an outstanding spectral efficiency (e.g., by the use of high order modulation schemes), albeit with a totally impractical or uneconomic system design. Any claims about spectral efficiency therefore have to be weighed very carefully against the other characteristics of the system design.

5. Operational Flexibility of Spread Spectrum

AMSC's assertion that "any or all of the proposed multiple access techniques can be applied in the multiple entry environment" is nothing more than a statement that all the contending multiple access techniques are viable satellite access techniques in very general terms. No one would argue with the fact that FDMA, TDMA and CDMA are all viable techniques, and the fact that they have all been used successfully in the past is evidence of this. The point that is relevant here is that it is important to choose an access technique that has the operational flexibility to adapt during the lifetime of the systems, to permit full use to be made of the available spectrum by as many different systems as possible. This requires that new entrants be permitted to start operations without major re-design of the existing systems. Conversely, if an existing system ceases to operate, then the spectrum resource that was being used by that operator should become available to the remaining operational systems. Because of the worldwide capability of the non-geostationary systems, this whole evolutionary process must also be considered in an international context, and not simply as a domestic US affair.

The suggestion by some parties that the available spectrum may not be sufficient to accommodate all the contending systems at full capacity (irrespective of the transmission scheme) is actually further reason to ensure that an access scheme is chosen that will permit multiple system entry (and exit). In the event that an authorized spread spectrum MSS system does not come to fruition, the unused "allocation" is fully available for the surviving systems to grow into, without the need for any further system changes for any of the systems. If one of the exclusive-use systems is authorized but not implemented, there is no domestic

system that will be able immediately to step in and fill the service void.

The only alternative to allow multiple entry without the use of a spread spectrum access technique is "band segmentation". Band segmentation is always a last resort in trying to solve interference problems. It requires all interested parties who might wish to make use of the spectrum to coordinate frequency allocations at the outset. In the case of the worldwide MSS systems considered here, this would inevitably require the participation, from the very beginning, of foreign governments and foreign satellite operators if a future international backlash is to be avoided. Previous examples of the application of this approach was the orbit planning derived at the WARC '77 for the Broadcasting Satellite Service, and at WARC '88 for Fixed Satellite Service. The general view of these types of planning exercise is that, quite apart from the time delay factor in reaching such international agreements, they result in denial of the available spectrum to likely users and "warehousing" of spectrum by parties who are very unlikely to ever make use of their allocations.

TECHNICAL CERTIFICATE

I, Richard J. Barnett, hereby certify that I am a technically qualified consulting engineer. I have reviewed the foregoing "Reply Comments of TRW Inc." and prepared the Technical Appendix that is attached thereto. I certify, under penalty of perjury, that the technical information presented is complete and accurate to the best of my knowledge, information, and belief.

Dated this 6th day of January 1993

By: _____
Richard J. Barnett

CERTIFICATE OF SERVICE

I, Kaigh K. Johnson, hereby certify that a copy of the foregoing "Reply Comments of TRW Inc." was served by first-class mail, postage prepaid, this 6th day of January 1993, on the following persons:

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