will no longer be a rigid prohibition, but a trigger for coordination.[9/]

TRW supports the Commission's proposal. Rather than arbitrarily barring systems that exceed the "trigger" levels from accessing the 2483.5-2500 MHz band, the regulations will require such systems to coordinate their spectrum use with terrestrial users to avoid harmful interference. Insofar as the actual procedures for coordination are concerned, TRW observes that these procedures are being developed in international fora with U.S. Government participation (and input from the putative LEO MSS operators). TRW believes that these processes should be allowed to develop appropriate coordination criteria, and that Commission specification of precise coordination procedures at this time would be premature and perhaps counterproductive.

Next, TRW supports the Commission's proposal to subject MSS use of the L-band segment to the EIRP density limits and coordination procedures set forth in international Radio Regulation Footnote 731X and Resolution Com 5/8, as adopted at WARC-92. See Notice, 7 FCC Rcd at 6417. Although, as noted above, these limits may preclude AMSC (and perhaps Motorola) from operating in the band, they facilitate the entry of multiple spread spectrum systems on a compatible basis with aeronautical radionavigation operators. As part of any domestic coordination

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9/ See Addendum and Corrigendum to Final Acts (WARC-92) at 21, Footnote 753X.

effort, however, domestic aeronautical radionavigation users should be required to assist in coordination with LEO MSS mobile terminals in whatever manner ultimately is deemed suitable by the Commission.

Finally, to the extent that any additional measures might be necessary to protect radioastronomy operators in the second harmonic frequencies at 4900-5000 MHz, these details can and should be addressed as part of the Commission's rulemaking proceeding in CC Docket No. 92-166 to develop technical and service rules for LEO MSS operations. Whatever such measures might be warranted, e.g., use of harmonic filters, the degree of difficulty involved in making satisfactory accommodations is sufficiently low that the potential need for such measures should not unduly concern the Commission or delay in any way the actions contemplated in this proceeding.

B. The Primary Uplink Allocation In The 1610-1626.5 MHz Band Is Compatible With RAS And GLONASS.

The Commission also solicited comment on whether MSS operations in the L-band might have a negative impact on either radio astronomy service ("RAS") or Global Navigation Satellite System ("GLONASS") operations in these bands. See Notice, 7 FCC Rcd at 6418 & n.23. In both cases, with respect to uni-directional LEO MSS uplink operations, there is no reason to expect that these uses cannot be successfully coordinated.

1. Radio Astronomy Service

TRW has demonstrated on several occasions that non-geostationary systems using spread spectrum techniques can co-exist with the RAS.[10/] Because RAS facilities are relatively isolated and few in number, the chances for any significant service disruption are remote.[11/] Indeed, in prior efforts to coordinate use of the 1610-1626.5 MHz band by RAS and the RDSS system proposed by the now defunct Geostar Positioning Corporation, it was determined that a 100 kilometer protection region around RAS sites was sufficient to ameliorate any interference problem. TRW notes that this assessment is based on the 40 Watt transmit power required for the Geostar terminals; transceivers for use by LEO MSS systems will require dramatically less power (in some cases, as low as 0.5 Watts).

10/ See Erratum and Technical Clarification to TRW Odyssey Application (File Nos. 20-DSS-P-91(12) and CSS-91-015), filed July 9, 1991, at 6 and C-4 to C-6; Reply Comments of TRW Inc., RM-7773 (filed November 14, 1991), at 14-17 and Technical Appendix thereto at A-2 to A-3; and Consolidated Opposition to Petitions to Deny and/or Dismiss and Reply Comments of TRW Inc., File Nos. 20-DSS-P-91(12) and CSS-91-015 (filed January 31, 1992), at 5-8.

11/ For example, one means of protecting RAS ground stations would be to require each one to transmit a beacon signal with a specified power level and coverage pattern. Mobile units would use this beacon to sense whether they are within the range where interference would be caused to the transmitting RAS station. When mobile terminals sensed such a beacon at the specified power, the ground user emissions could be shifted to upper bands, away from the proposed primary RAS allocation at 1610.6-1613.8 MHz, in order to avoid interference.

2. GLONASS

As with RAS, there is every reason to believe that technical coordination can be accomplished between the proposed GLONASS system and multiple LEO MSS providers, based on characteristics of TRW's Odyssey system and on what is currently known about the GLONASS system. These characteristics include the opposite circular polarization of transmissions between the two services; the small probability that GLONASS receivers and Odyssey transmitters will be in close proximity for any substantial period of time; the fact that momentary interference is unlikely to degrade either the quality or the accuracy of GLONASS transmissions; and the Odyssey system's ability, due to its low EIRP spectral density, to take advantage of modifications to international radio regulations that were adopted at WARC-92 and share any portion of the LEO MSS L-band with GLONASS without the need for direct coordination.

C. Even If The Commission Does Not Make Specific Feeder Link Allocations, It Should Ensure The Availability Of Spectrum For LEO MSS Feeder Link Operations.

In its Notice, the Commission declined to propose specific feeder link allocations for LEO MSS operations and, in fact, specifically rejected one party's proposal to use C-band frequencies for this purpose. Notice, 7 FCC Rcd at 6418. Instead, it proposed to allow LEO MSS providers to use existing

Fixed-Satellite Service ("FSS") frequency bands for feeder link operations. Id.

The existing FSS bands (especially FSS allocations in the Ka-band) could provide sufficient capacity for LEO MSS feeder links if non-geostationary systems are simply required to coordinate their use with geostationary FSS systems that may ultimately be authorized, without the latter being given priority. To that end, the Commission should clarify that the Ka-band frequencies proposed for combined FSS and MSS use also remain available for users such as TRW, which propose to use the FSS portion of the allocation in the manner prescribed by Part 25 of the Commission's rules. Specifically, Section 25.202(a)(2) of the Commission's rules provides that "[f]ixed-satellite service frequencies may be used for links between radiodetermination satellites and control centers. . . ." See 47 C.F.R. § 25.202(a)(2).

TRW believes that its proposal to utilize Ka-band FSS frequencies for feeder links for its Odyssey system RDSS and MSS service is fully consistent with this regulation. Still, in view of the pendency of a proposal to reallocate portions of the Ka-band to MSS (on a co-primary basis with FSS),[12/] TRW urges that the Commission explicitly rule in this proceeding that the

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12/ See Amendment of Section 2.106 of the Commission's Rules to Upgrade to Primary Status the Secondary Mobile-Satellite Service Allocation at 19.7-20.2 GHz and 29.5-30.0 GHz (ET Docket No. 92-191), 7 FCC Rcd 5626 (1992); Comments of TRW Inc., ET Docket No. 92-191 (filed November 2, 1992).

feeder links associated with LEO MSS systems operating in the 1610-1626.5 MHz and 2483.5-2500 MHz bands may continue to be located in the Ka-band FSS frequencies in which co-primary status for MSS has been proposed. TRW's request is fully in accord with the international agreements adopted at WARC-92. In particular, it was clearly understood among delegates to WARC-92 that Radio Regulation Footnote 873E did not preclude the use of FSS frequencies for existing permitted uses, including RDSS feeder links.[13/]

Finally, TRW recognizes that international Radio Regulation No. 2613 limits transmissions by non-geostationary satellites in certain situations when unacceptable interference is caused to geostationary FSS satellites.[14/] However, because

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13/ See International Telecommunication Union, Final Acts of the World Administrative Radio Conference (WARC-92) at 23 (Malaga-Torremolinos, 1992) ("Final Acts (WARC-92)"). TRW also notes that it is not clear whether international Radio Regulation Footnote 873E requires both MSS and FSS uses to occur in the Ka-band frequencies. The Odyssey system is a mobile-satellite system, but because its use of the Ka-band only for feeder links is consistent with the original fixed-use purposes for which the spectrum was allotted, there appears to be no reason that TRW would be penalized for not actually proposing to use these particular frequencies to provide mobile services as well.

14/ The Commission "noted" that, at WARC-92, international Radio Regulation No. 2613 was modified "to clarify that non-geostationary satellite operations are secondary to geostationary operations in the fixed-satellite service." Notice, 7 FCC Rcd at 6418 (footnote omitted). TRW observes, for the record, that Radio Regulation No. 2613 does not relegate non-geostationary operation to "secondary" status with regard to geostationary FSS operations. See footnote 7, supra. Instead, it specifies

(continued...)

the Commission has expressly recognized that existing "fixed-satellite service allocations can be used for [LEO MSS] feeder links, . . ."[15] the Commission should override the impact of Radio Regulation No. 2613 in the Ka-band for U.S. domestic systems. Specifically, TRW believes the Commission should adopt a new U.S. Footnote that excludes non-geostationary LEO MSS systems operating in the 1610-1626.5 MHz and 2483.5-2500 MHz frequency bands and using feeder links in the 19.7-20.2 GHz and 29.5-30 GHz from the operation of international Radio Regulation No. 2613.[16] TRW made the same proposal in its Comments in the ET Docket No. 92-191 rulemaking proceeding (see supra at n. 12), and would accept Commission action in either that proceeding or the instant one.

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[14] (...continued)
that:

> Non-geostationary space stations shall cease or reduce to a negligible level their emissions, and their associated earth stations shall not transmit to them, whenever there is insufficient angular separation between non-geostationary satellites and geostationary satellites resulting in unacceptable interference to geostationary-satellite space systems in the fixed-satellite service operating in accordance with these Regulations.

Final Acts (WARC-92), Article 29, at 51.

[15] Notice, 7 FCC Rcd at 6418.

[16] This Footnote, USXXX, would read as follows: "RR 2613 shall not be applied to require non-geostationary MSS systems to cease or reduce feeder link operations in the 19.7-20.2 GHz and 29.5-30.0 GHz bands."

D. Hand-held Transmit/Receive Devices Required For Spread Spectrum LEO MSS Systems Will Pose No Radio Frequency Radiation Exposure Threat To Odyssey System Users.

The Commission also expressed some concern in its Notice that hand-held transceiver devices proposed for use with LEO MSS systems might possibly create radio frequency ("RF") fields that would be harmful to human health. Notice, 7 FCC Rcd at 6418. In general, the non-geostationary spread spectrum systems that have been proposed will permit use of sufficiently low-power hand-held transceivers (e.g., the Odyssey handset will radiate at approximately 0.5 Watts) that there will be no health threat to users under the revised standards approved by the Institute of Electrical and Electronics Engineers ("IEEE").[17] By comparison, terrestrial cellular handsets typically radiate at 0.6 watts, but some units radiate as high as 1.2 watts.

The Commission also raised questions concerning possible variations in the hazard posed by RF radiation that might be related to the use of digital (versus analog) signals, to differences in frequency, or to exceeding a particular maximum

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[17] To the extent, however, that any geostationary MSS system might attempt to utilize hand-held devices, these would likely pose a health hazard because of the higher transceiver power required in order to reach satellites in higher orbits. The only way to reduce the required power for the hand-held transmitters to a safe level would be to use very large, very expensive satellite antennas. Thus, this particular issue highlights the inherent limitations of geostationary satellites for providing truly personal mobile satellite communication.

power level. Notice, 7 FCC Rcd at 6418. With respect to the first of these inquiries, TRW notes that only certain digital signals, such as those used in radar systems, pose a substantially enhanced RF health risk (vis-a-vis analog signals). The Odyssey system is unaffected, as it uses digital signalling formats with electromagnetic characteristics that are substantially the same as analog signals, and thus causes no greater risk of exposure to harmful RF radiation.

The answers to the two remaining questions are related. Namely, the problems posed by RF emissions vary depending upon both frequency and power. Indeed, this is the major import of the recent IEEE study. Using the worst case calculations, actual emissions from Odyssey handsets are likely to be substantially less than the power densities projected using the cautious IEEE standards. In any event, TRW will take all necessary precautions to ensure that its handsets comply with the applicable standards.

Finally, if the Commission does decide to address this issue, TRW believes it should do so in the course of a separate rulemaking proceeding dedicated to the issue of RF radiating devices. Such an approach would avoid the possibility that different types of devices causing similar RF exposure levels might be treated dissimilarly.

IV. THE COMMISSION SHOULD FINALIZE ITS DETERMINATION THAT NO PIONEER'S PREFERENCE SHOULD BE AWARDED IN THE LEO MSS PROCEEDING.

In its Notice, the Commission addressed five separate requests for pioneer's preferences, and tentatively concluded that no preference should be awarded in the LEO MSS proceeding. Although TRW's own proposal was one of the ones rejected by the Commission (see Notice, 7 FCC Rcd at 6420-21),[18/] TRW believes that the Commission pursued the most prudent and reasonable course in declining to determine that any of the applicants should receive a pioneer's preference. The Commission's tentative conclusion that no single applicant should be favored is fully consistent with the applicants' desire to expedite the inauguration of LEO MSS service. For this reason, among others, the tentative decision should now be finalized.

V. CONCLUSION

In light of the spectrum sharing efficiencies available through the use of spread spectrum CDMA modulation, and the accompanying benefits of multiple LEO MSS systems, the Commission should explicitly reject those proposals seeking allotment of the former RDSS spectrum for monopoly geostationary or non-geosta-

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18/ Despite the reasonableness of the Commission's approach as a practical matter, TRW does believe that the Commission was factually incorrect to the extent that it determined that TRW's Odyssey proposal did not merit a pioneer's preference.

tionary services, and adopt instead the pro-competitive MSS spectrum allocation scheme proposed in the Notice. Once the allocation is made, the Commission should then move forward expeditiously to the adoption of system rules and standards, and grant of the pending applications of TRW and other spread spectrum systems.

Respectfully submitted,

TRW Inc.

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ATTACHMENT

NEW STUDY: VOICE MARKET WILL BE TOUGH TO REACH FROM GEO

American Mobile Satellite Corp. (AMSC) may be on track to launch its satellite system ahead of low-earth-orbit (LEO) competitors, but the company will face serious problems in providing service to handheld terminals, according to a new study of small satellites (SN, Oct. 26, pp. 6-7).

"AMSC, Inmarsat and the Big LEOs will be targeting virtually the same market," says the study, "Smallsats-Proposals & Prospects for Mobile Communications." Produced by Leslie Taylor Associates and distributed by Phillips Business Information, Inc.--publishers of SATELLITE NEWS, HDTV REPORT, VIDEO TECHNOLOGY NEWS and HOME MEDIA TECHNOLOGY NEWS--the $995, 249-page study predicts that the physics of geosynchronous satellites will prove a disadvantage as they compete with the LEOs.

"The physics of using a repeater in geosynchronous orbit (GSO)--22,300 miles above the Earth--to communicate with a small, omni-directional, relatively low-power antenna on the ground, result in both a delay for each side of a conversation as well as a noticeable echo after each person speaks," the study says. "Whether this will be acceptable to a large consumer base is uncertain."

AMSC additionally will face the challenge of avoiding biological hazards in delivering a signal from a handset to geostationary orbit. "These challenges, coupled with the delay in signal transmission from GSO, is likely to disadvantage GSO mobile satellite systems *vis a vis* the LEO systems," the report says.

Churning Out Birds

But the LEOs will face their own challenges in successfully completing and launching the satellites needed to support their plans. While the study reports that there is "little, if any, technical uncertainty" associated with the planned AMSC space network, it notes that manufacturers for the LEOs will need to construct 10-30 satellites a year.

"Most manufacturers are accustomed to turning out no more than five or six satellites a year," the study says. On the question of how the new bunches of satellites will reach their orbits, the study predicts that "increased emphasis on commercial development of expendable launch vehicles will improve the prospects for launch availability and alternatives."

"The Chinese Long March and Russian Proton programs could also be pressed into service to meet the LEO requirements," the study says.

The report adds that both the LEOs and AMSC will face a challenge as the reach of terrestrial cellular systems increases.

"As time passes," the study says, "there will be fewer gaps in cellular coverage, given the rapid build-out of the [Rural Service Areas], and the aggressive marketing efforts of the major cellular carriers to extend cellular coverage to the extent possible and to reduce difficulties for roaming use."

More Outlooks and Predictions

Despite the growth in cellular coverage, the study predicts that the international market will support at least two Big LEO systems and possible more. The report also forecasts some success for AMSC in the maritime market within 200 miles of the Untied States coastline.

Additional forecasts offered in the study include:

- One or two big LEO systems will be operational by 1997 or 1998;
- The Big LEO systems will need to use additional spectrum in their follow-on systems to meet market demands;
- Inmarsat will continue to dominate the maritime market in the oceanic regions until the late 1990s;
- Inmarsat will likely opt for a non-geostationary system for a follow-on to

its third generation, though the system will not be deployed until the 21st century unless Inmarsat enters into a joint venture with one of the current LEO applicants;

- AMSC's primary success will come in providing communication service for vehicles;
- Ramp up usage of Big LEO systems may be slower that predicted in the initial one to three years of service, but will outpace current predictions in later service years.

A Look at Little LEOs

The report also includes outlooks for the small satellite systems operating below 1 GHz, known as the Little LEOs.

LEOS BELOW 1 GHZ

SYSTEM	NO. SATELLITES	COST	MARKET FOCUS	SERVICES
Orbcomm	20	$320 m	Global	Messaging/ pos.deter.
Starsys	24	$197 m	Global	Messaging/ pos. deter.
VITA	2	$5.3 m	Developing countries	Messaging

SOURCE: FCC applications

Combined projected revenues for the Little LEOs, the study says, total $1.1 billion by 2001.

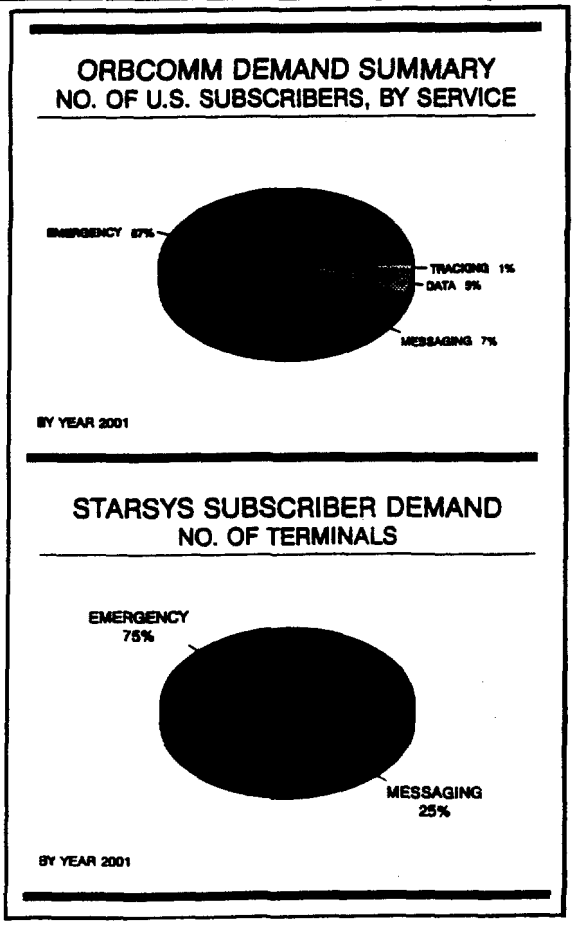
"Little LEOs have set their marketing objectives on various subsets of the populations," the report says. Orbcomm, for example, expects the bulk of its business to come from emergency service features. The firm, according to the study, expects more than 4.5 million subscribers by 2001 and $156.6 million in revenues. "Orbcomm estimates that the total addressable U.S. market for emergency services is more than 100 million subscribers," the report says.

Starsys also expects large returns in emergency services, but places a greater emphasis on messaging in its business plan. The company anticipates a 10 percent U.S. market penetration and in its FCC application forecasts approximately $559 million in revenues by 2001.

"Starsys sees demand from the automotive sector comprising 40 percent of the demand, with health care at 20 percent, recreational equipment 15 percent, mobile communications 15 percent and environmental protection 10 percent," the report says.

Volunteers in Technical Assistance (VITA), meanwhile, is planning to offer its network capacity on a non-common carrier basis to other aid organizations and users in developing countries. The system, which won a Pioneer's Preference award from the FCC, is aimed at providing medical information, educational services and disaster relief.

The report includes Leosat's projection of approximately $300 million in revenues by 2001, though it also notes the FCC's decision to reject the Leosat application. The firm currently is seeking a review of the decision. (Phillips Business Information, Inc., 7811 Montrose Road, Potomac, MD 20854, 800/777-5006.)



TECHNICAL DECLARATION

I, Richard Barnett, hereby certify that I am a technically qualified consulting engineer. I have reviewed the foregoing "Comments of TRW Inc." and 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 2nd day of December 1992

By: Richard Barnett

Richard Barnett