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Federal Communications Commission
Office of the Secretary

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

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| In the Matter of the Application of | ) | |
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| ORBITAL COMMUNICATIONS CORPORATION | ) | File No. |
| | ) | 22-DSS-MP-90(20) |
| For Authority to Construct a Low-Orbit Mobile Satellite System | ) | |
| | ) | |

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MAY 18 1990
Domestic Facilities Division
Satellite Radio Branch

## COMMENTS

Geostar Corporation is filing these comments regarding the application of Orbital Communications Corporation (Orbcomm) for authority to construct a low-earth orbit mobile satellite system.

Geostar Corporation has two wholly owned subsidiaries. One of these, Geostar Positioning Corporation (GPC) is a Commission licensee in the radiodetermination satellite service (RDSS).[1] The other subsidiary, Geostar Messaging Corporation (GMC), is an applicant for a domestic mobile satellite system.[2]

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1 *Geostar Corporation*, Mimeo 6144, August 7, 1986. GPC is authorized to construct, launch and operate three dedicated RDSS satellites, and is currently providing an interim RDSS service to 70 commercial and government customers.

2 On June 18, 1988, GMC filed an application for a digital land mobile satellite system in the 1530-1544 and 1626.5-1645.5 MHz bands, as well as a petition for rulemaking (RM-6459) to allocate these frequencies for domestic mobile satellite service and establish licensing policies and procedures. The Commission has acted on GMC's petition to the extent of issuing a notice of proposed rulemaking in Gen. Docket 90-56 to allocate these frequencies for domestic mobile satellite use. *Notice of Proposed Rule Making*, FCC 90-63 (March 5, 1990).

Orbcomm's proposed low-earth orbit mobile satellite system is intended to meet the demand of the American public for emergency service, data acquisition, tracking and two-way messaging on thin routes.[3] Although Orbcomm will be a competitor, Geostar does not object to Orbcomm's application to operate a low-earth orbit satellite system in the 137-138, 148-149.9 and 400.075-400.125 MHz bands. However, these services can also be provided by geostationary satellites in an efficient and economical manner, and Geostar wishes to draw the Commission's attention to the following factors when it evaluates Orbcomm's application.

Orbcomm claims the following advantages for low-earth orbit satellite systems:

> Use of the low-earth orbit, some 95% closer to the user than geostationary satellites, permits VHF and UHF frequencies and low power levels to be used, resulting in low-cost subscriber equipment and simple antennas. . . . Indeed, the low altitude of the satellites decreases the beam power densities required for communications by a factor of approximately 150-1,000 compared to geostationary satellites. Notwithstanding the considerably lower costs of VHF and UHF electronics, perhaps the biggest difference is in the size and cost advantage of the mobile antennas (and hence of the terminals). (footnote omitted).[4]

However, these claims do not hold up when viewed in the proper context.

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3 *See e.g.* Orbcomm *Application* at Table III-1.

4 Orbcomm *Application* at page 3-4.

The factor of 150 to 1,000 (21.8 to 30 dB) refers only to the spreading of the radio wave energy over an increasingly large spherical surface as the radio wave travels farther and farther from the transmitter. The magnitude of this spreading factor is smaller for low-earth orbiting satellites than for geostationary satellites because the low-earth orbit satellites are closer to the earth. However, it is cancelled by the fact that the United States occupies a much larger angular area when viewed by a low-earth orbit satellite than by a geostationary satellite. In other words, the gain of a satellite antenna covering the United States on a low-earth orbit satellite has a much lower antenna gain[5] than an antenna covering the United States on a geostationary satellite. Thus, when the entire link performance is put together, including both the spreading loss and the satellite antenna gain, there is little difference between low-earth orbit and geostationary power requirements.

This conclusion is illustrated by a comparison of Orbcomm and GMC parameters for omnidirectional user terminals operating at similar data rates. In the downlink direction, Orbcomm's low-earth orbit satellites produce a power flux density level between -123.4 and -131.2 $dBW/m^2$-4 kHz[6] while GMC's geostationary satellites

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5 In the uplink direction, a low-earth orbit satellite has a lower gain-to-temperature ratio (G/T) because the relatively high temperature earth occupies a much larger angular area seen the antenna. For example, the G/T of the Orbcomm satellite is -25.8 dB/K, Orbcomm *Application* at Table V-10, page 104, while that of the GMC satellite is 4.2 dB/K, GMC *Application* at Appendix H.

6 Orbcomm *Application* at Table V-4, page 80.

produce a power flux density level of -136.2 dBW/m$^2$-4 kHz[7]. Moreover, the satellite power required by GMC per channel is lower than that specified in Orbcomm's application.[8] In the uplink direction, the transmitter power of Orbcomm's mobile terminals is 2 to 5 watts[9] while that of the GMC terminals is 2 watts or less[10]. Thus, when considering the entire link, there is little if any difference between low-earth orbit and geostationary satellite power requirements.

Orbcomm's claim that it can achieve a retail price of $50 to $150 per terminal[11] should also be viewed in context that these figures appear to be based on a production run in the millions of identical Orbcomm user terminals. However, if the prices of terminal equipment in geostationary RDSS or mobile satellite systems were also based on production runs in the millions, these prices would drop drastically below the current $1,000 to $4,000 price per terminal figure mentioned by Orbcomm[12].

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7 GMC *Application* at Appendix A, page A-15.

8 Orbcomm specifies a satellite transmit power (into the antenna) of 10 watts per 4800 bps channel at VHF. Orbcomm *Application* at Table V-10, page 105. For a 4800 bps channel on the GMC satellite, 0.3 watts/channel are needed for spot beam operations and 5.9 watts/channel if a continental United States coverage beam with 12.4 dB less gain were used. See GMC *Application* at Appendix H.

9 Orbcomm *Application* at Table V-9, page 103.

10 GMC *Application* at Appendix E, Table E.1 for the case of 4800 bps transmission. For 1200 bps transmission, the power can be reduced to 600 milliwatts.

11 Orbcomm *Application* at page 8.

12 Orbcomm *Application* at page 4, note 4.

Orbcomm also claims that its system will be spectrum efficient, stating that:

> . . . the system will support approximately 10,000 to 20,000 subscribers per kilohertz of bandwidth; a subscriber to bandwidth ratio that ORBCOMM believes is unmatched by any other communications service.[13]

However, the corollary of this claim is that each subscriber gets very little individual use of the system.[14] For example, it there were 100% perfect utilization of Orbcomm's twenty 1200 bps uplink channels with each of the 20 million subscribers envisioned by Orbcomm using the system for equal periods of time, then each user would have to wait over 55 hours between 30 character messages. Since access to these inbound channels is on a contention basis, a more realistic waiting time would be three times as long. In contrast, GPC's RDSS system is designed to provide over a million subscribers with a position fix and up to a hundred character message (in addition to the acquisition sequence, user identification, and other system overhead) at least once an hour, 24 hours a day. Moreover, a comparison between the 898 kHz requested by Orbcomm for a very light duty cycle service, and the 28 MHz requested by GMC for

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13 Orbcomm *Application* at page 18.

14 Orbcomm admits that "the communications system is designed to use satellite/subscriber transmissions only where absolutely necessary, i.e. for occasional communications to or from subscribers rather than frequent or continual use." Orbcomm *Application* at page xv.

continuous two-way voice, data and facsimile services is not a very meaningful one.[15]

Orbcomm expects that over 85% of its subscribers will fall into the emergency services category.[16] For example, it describes one particular application as follows:

> The ORBCOMM system will provide a cost effective way to call for help, whether one is walking down the street, at home, or sitting in an automobile. This "911" capability, coupled with the ability to determine automatically the position of the caller, should be of great value to potential subscribers and to the police, who need to know when and where someone needs help.[17]

However, geostationary systems, such as Geostar's RDSS system, are more likely to be able to provide such emergency service capabilities with greater reliability.

The low-earth orbit Orbcomm system will provide coverage of a particular locale for only about 95% of the time[18], implying that service will not be available for some 72 minutes a day. A geostationary satellite, on the other hand, provides continuous

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15 Orbcomm requires approximately 15 kHz of channel bandwidth for a 1200 bps transmission and 27 to 40 kHz for a 4800 bps transmission, which is substantially more than that required by geostationary satellites. *See* Orbcomm's *Application* at Table V-2, page 73. Of these required bandwidths, about 28% of the VHF downlink and 49% of the UHF downlink is allocated to "position determination spectrum", *i.e.* doppler shift, undercutting Orbcomm's statement that position determination "is a free side-benefit of the architecture of the systems." Orbcomm *Application* at page 20.

16 Orbcomm *Application* at page 18.

17 Orbcomm *Application* at page 12.

18 Orbcomm *Application* at page iv.

service 60 minutes an hour, 24 hours a day. In the case of a geostationary satellite failure, service is restored within minutes as service is switched to the in-orbit backup satellite. In the case where a low-earth orbiting satellite fails, it will be a significant period of time before the launch of a replacement satellite can restore the service lost as a result of the missing satellite in the constellation to the normal 95% level.

Moreover, in a geostationary RDSS satellite system, position fixes are determined to an accuracy of 50 meters at the central earth station within seconds of receipt of a single transmission burst containing an emergency priority code. In the low-earth orbit Orbcomm system using doppler ranging, the lowest cost emergency terminal requires 7 minutes to get a position fix within 3,600 feet (0.7 mile) and 24 minutes to get a position fix within 2,500 feet (0.5 mile).[19] Moreover, the Orbcomm terminal has to contend with the other subscribers assigned to the channel, some of which are likely to be the heavier users such as data acquisition and messaging services which "will be randomly assigned in the manufacturing process."[20] Thus, the amount of time needed for an emergency alert, including an accurate position fix, will take much longer in a low-earth orbit system than a geostationary RDSS system.[21]

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19 Orbcomm *Application* at Table V-11. These values are for single frequency, 137 MHz position determination.

20 Orbcomm *Application* at page 100.

21 Collisions between incoming messages, and the resulting delays in retransmitting lost messages, are likely to be more common in the Orbcomm system than in the GPC RDSS system. In the spread spectrum, code division multiple access architecture used in RDSS, a destructive collision occurs

In comparing low-earth orbit satellites with geostationary satellites for position determination, Orbcomm further claims that geostationary satellites require costly satellites, and the addition of relatively expensive electronics or highly specialized satellites.[22]

While a geostationary satellite may cost more than a low-earth orbit satellite, geostationary system cost can be less than a low-earth orbit system since fewer satellites are needed. Moreover, with the much higher capacity of a GPC RDSS system or a GMC mobile satellite system in geostationary orbit, the price of equivalent service to the user is likely to be lower.[23]

With respect to the need for additional equipment to do positioning, even in Orbcomm's system the cost of the user terminal increases by at least $100 with the addition of a positioning capability.[24] There is no additional cost for the position determination of an RDSS user terminal since the position fix is done

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between two inbound transmission bursts only if they are received within two chips (250 nanoseconds in the case of the Geostar system). On the other hand, a destructive collision occurs in the Orbcomm system if two inbound transmissions overlap for any significant period of time. In this case, the overlap period could amount to the 0.3 seconds required for transmitting a typical 30 character message at 1200 bps. Orbcomm *Application* at page v.

22 Orbcomm *Application* at page 2.

23 For example, Geostar currently charges $0.05 per position fix and optional 100 character message in its RDSS system. Assuming Orbcomm's $30 to $50 dollar annual subscriber fee for emergency service allowed each user to transmit a message every 55 hours, the price would be $0.19 to $0.31 per 30 character message. However, Orbcomm indicates that it also plans to charge a fee for each use as well. See Orbcomm *Application* at page 46.

24 Orbcomm *Application* at page 8.

at the central earth station. Thus, low-earth orbiting satellites do not appear to offer any significant advantages over geostationary satellites for position determination.

Finally, Orbcomm urges prompt action on its application[25], and Geostar urges similarly prompt consideration of GMC's pending mobile satellite application. While the Commission promptly issued a public notice of the acceptance of Orbcomm's application, disparately slow treatment has been given to GMC.[26] Geostar hopes that the Commission promptly remedies this matter.

Respectfully submitted,

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May 14, 1990.

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25 *See e.g.*, Orbcomm *Application* at page viii.

26 Orbcomm's application was accepted for filing and placed on public notice seven days after the Commission issued its public notice of Orbcomm's petition for rulemaking and less than 45 days after filing. In contrast, GMC's application has been on file with the Commission since June 18, 1988 with no action being taken by the Commission to accept and process it. Moreover, the Commission has yet to provide an adequate explanation of its apparently arbitrary and capricious treatment of GMC's applications. *See Comments* of Geostar Messaging Corporation filed May 11, 1990 in Gen. Docket 90-56.

CERTIFICATE OF SERVICE

I, Christine A. Brazeau, certify that on this 14th day of May 1990, copies of the foregoing "COMMENTS" of the Geostar Corporation concerning the application, File No. 22-DSS-MP-90(20), filed by Orbital Communications Corporation were mailed by U.S. first class mail, postage prepaid, to the following:

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