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Satellite Policy Branch

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In the Matter of FINAL ANALYSIS COMMUNICATIONS SERVICES, INC. Application for Authority to Construct, Launch and Operate Non-Voice, Non-Geostationary Mobile-Satellite System in the 137-138 MHz, 148-150 MHz and 400-401 MHz Bands	File No. 25-SAT-P/LA-95

Received
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Satellite and Radiocommunication Division
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COMMENTS OF ORBCOMM

Orbital Communications Corporation ("ORBCOMM") hereby comments on the Application recently filed by FINAL ANALYSIS COMMUNICATIONS SERVICES, INC. ("Final Analysis").[1/] In that Application, Final Analysis requests authority to construct, launch and operate a 26 satellite system in the Non-Voice, Non-Geostationary ("NVNG") mobile satellite service. As discussed below, ORBCOMM urges the Commission not to grant the Final Analysis application.

ORBCOMM was the first proponent and applicant for NVNG satellite services, having filed its petition for rulemaking and application in February 1990.[2/] ORBCOMM was one of three

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[1/] Public Notice, Report No. DS-1484, November 25, 1995.

[2/] Orbital Communications Corporation, RM No. 7334, Public Notice Report No. 1814, April 4, 1990; Orbital Communications Corporation, File No. 22-DSS-MP-90(20), Public Notice Report No. DS-953, April 11, 1990.

applicants being considered in the first NVNG satellite service processing round, and also became the first NVNG satellite service licensee.[3/] ORBCOMM has also filed a request to modify its system by adding twelve satellites to its constellation (necessitating a slight increase in required spectrum) and moving its gateway uplink to the Transit Band (149.9-150.05 MHz).[4/] Final Analysis is an applicant in the second NVNG satellite service processing round, and its proposed system may impact the ORBCOMM licensed system (as well as the proposed ORBCOMM modification). Thus, ORBCOMM has a significant interest in the Final Analysis Application.

As an initial matter, ORBCOMM observes that Final Analysis is not financially qualified to become an NVNG satellite system licensee. Final Analysis estimates that it will be able to construct, launch and operate for one year the initial two satellites in its constellation for only $6.2 million. ORBCOMM believes that Final Analysis has significantly underestimated its costs. Final Analysis shows a total system cost of some $140 million for construction and launch of its satellite constellation -- FAISAT 1a-26 (Figure VII-2A). Thus, on an average basis, it claims it will cost over $5 million per satellite to construct and launch its satellites. For the initial two satellites, Final Analysis is claiming that it will

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3/ Orbital Communications Corporation (Order and Authorization), 9 FCC Rcd 6476 (1994).

4/ Orbital Communications Corporation, File No. 28-SAT-MP/ML-95, Report No. DS-1484, released November 25, 1994.

cost only $3.1 million per satellite for construction, launch and the first year of operations.

If anything, ORBCOMM would expect that the costs of the initial two satellites would be disproportionately high, not disproportionately low. Indeed, ORBCOMM's actual experience has been that the per satellite cost for the initial two satellites is significantly higher than the per satellite cost of subsequent satellites in the constellation, particularly when the up-front development costs are properly attributed to the initial satellites.[5/] Thus, Final Analysis appears to have significantly underestimated its costs for the initial two satellites in its constellation.

Even putting aside the Final Analysis understatement of the costs that it must demonstrate it has the ability to fund, Final Analysis has not demonstrated the resources to meet even the $6.2 million it asserts will be necessary. As of October 31, 1994, Final Analysis showed that its parent had current assets of approximately $700,000 and operating income of roughly $1.3 million, far less than the $6.2 million Final Analysis claims it will need.[6/] Final Analysis clearly cannot rely on the

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[5/] Indeed, ORBCOMM found that its actual costs for the construction, launch and first year of operations for the initial two satellites in its system was more than ten times Final Analysis' estimate of $6.2 million as the cost to construct, launch and operate for one year the initial two satellites in the Final Analysis system.

[6/] ORBCOMM also is concerned with respect to the reliability of the financial information provided by Final Analysis. For example, Exhibit VII-2, which is an audited financial statement for Final Analysis, Inc., shows that for 1993, net income was $1,121,883; Exhibit VII-1, which is also an audited financial statement for Final Analysis, Inc., shows a net income for 1993 (continued...)

internal resources of its parent for financing, and Final Analysis has identified no other acceptable sources of funding. Thus, Final Analysis is not financially qualified to become an NVNG satellite system licensee.

ORBCOMM also has concerns with the technical aspects of the Final Analysis proposed satellite system. In the 137-138 MHz band, Final Analysis apparently relied on an outdated frequency plan in selecting its downlinks.[7/] Final Analysis will cause interference to ORBCOMM because both systems would be using the 137.655-137.745 MHz band, and both will be operating right hand circularly polarized.[8/] Attachment 2 shows that both systems cannot operate co-frequency.

In addition to Final Analysis' incompatibility with the licensed ORBCOMM system for the 137-138 MHz band, with respect to the 148-149.9 MHz band, ORBCOMM is concerned that Final Analysis' channel assignment proposal may not be effective in avoiding harmful interference, insofar as it has not indicated an intention to utilize a predictive algorithm for channel selection like ORBCOMM's Dynamic Channel Activity Assignment System ("DCAAS"). Moreover, because the user terminal will utilize

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[6/] (...continued)
of $420,904. While this discrepancy may reflect the fact that the larger amount was intended to show 1994 part year income, mistakes of this sort call into question the accuracy of all of the information presented in the audited financial statements.

[7/] ORBCOMM's current frequency plan for the 137-138 MHz band (not taking into account its modification request) is attached as Exhibit 1 to these comments.

[8/] The problem is further exacerbated when considering ORBCOMM's request for a slight additional amount of downlink spectrum in its proposed modification, because there will be additional frequency overlaps.

linear polarization, the fact that Final Analysis proposes to operate cross-polarized with ORBCOMM will not impact intersystem sharing.

Although some sharing of the upper portion of the 148-149.9 MHz band for uplinks is possible, it will require careful use by, and coordination among, the different satellite systems to minimize risks of interference. Moreover, while ORBCOMM continues to believe that multiple systems can coexist in the uplink bands, ORBCOMM does not believe that all of the proposed second round applicants that requested use of the upper portion of the 148-149.9 MHz band, which includes Final Analysis, can be accommodated.[9/] In addition, there are multiple applications for the Transit Band (149.9-150.05 MHz) for gateway uplinks, and that limited amount of spectrum is inadequate to fulfill all of the requests. In sum, the Commission cannot possibly accommodate the needs of all of the second round NVNG satellite service applicants without an additional allocation of spectrum.

The Commission is already studying the issue of an additional global allocation of spectrum below 1 GHz for low-Earth orbit satellite systems in the context of determining a U.S. position at the upcoming World Radiocommunication Conference ("WRC").[10/] The apparent excess of demand for spectrum over the

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[9/] Attachment 2 addresses the interference to the licensed ORBCOMM system from all of the different second round applications. In light of the substantial overlaps either with ORBCOMM or among the other second round applications, ORBCOMM does not believe that all of the proposed systems can co-exist.

[10/] Preparation for International Telecommunication Union World Radiocommunication Conference, IC Docket No. 94-31, FCC No. 95-36, released January 31, 1995.

available supply highlights the prematurity of the Commission's second NVNG satellite service processing round. The Commission cannot possibly seek to license additional systems without yet knowing how much spectrum is available. The Commission has not yet completed the initial processing round, and indeed to ORBCOMM's knowledge has not yet even established a U.S. position to take at the upcoming WRC with respect to an additional global allocation of spectrum below 1 GHz for low-Earth orbit satellite services. Thus, at the very least, ORBCOMM urges the Commission not to process the second round applications until these outstanding issues are resolved and can be factored into the second processing round.

In sum, because Final Analysis is not financially qualified, and because the Final Analysis satellite system will likely cause harmful interference to the ORBCOMM system, ORBCOMM urges the Commission not to grant the Final Analysis application.

Respectfully submitted,

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Attachment 1
ORBCOMM Revised Frequency Plan

Table 1 lists the revised frequency and polarization plan for the ORBCOMM constellation. The plan is based on keeping the ORBCOMM downlinks on the outer edges of the primary allocated downlink band to minimize the potential interference to Starsys. The LHCP downlink channels are grouped together to aid in obtaining a possible filtering solution to Starsys' interference problem. In addition to providing a benefit to Starsys, this frequency plan also maintains sufficient frequency separation from the National and International meteorological satellite bands to ensure that no interference occurs to these operations.

Table 1 ORBCOMM Revised Frequency Plan

Channel Number	Center Frequency MHz	Required Bandwidth kHz	Polarization
S-1	137.1900	15	LHCP
S-2	137.2050	15	LHCP
S-3	137.2200	15	LHCP
S-4	137.2350	15	LHCP
S-5	137.2500	15	LHCP
S-6	137.2650	15	LHCP
S-7	137.2800	15	LHCP
S-8	137.2950	15	LHCP
S-9	137.3100	15	LHCP
S-10	137.3825	15	RHCP
S-11	137.3975	15	RHCP
S-12	137.6625	15	RHCP
S-13	137.6775	15	RHCP
S-14	137.6925	15	RHCP
S-15	137.7075	15	RHCP
S-16	137.7225	15	RHCP
S-17	137.7375	15	RHCP
S-18	137.8050	15	RHCP
Gateway	137.5600	50	RHCP

Attachment 2
Sharing Analysis

1. Introduction

In this section, the interference levels into ORBCOMM receivers from the six second round applicants are calculated (Tables A2-1 and A2-2) based on link budgets presented in the ORBCOMM Amended Application.

2. Approach and Assumptions

A performance analysis, shown in the following tables, was conducted to determine received carrier power levels and power margins in the ORBCOMM system in the presents of co-channel interference from carriers of the second round applicants. A static analysis was completed for each proposed system wherein the carrier-to-interference ratio was calculated. Interference to ORBCOMM was analyzed for both interference to the gateway links and interference to the subscriber link. Specifically, this includes:

- interference from the proposed gateway of a second round applicant to the ORBCOMM gateway uplink
- interference from the proposed subscriber to the ORBCOMM subscriber uplink,
- interference from the proposed gateway downlink to the ORBCOMM gateway downlink, and
- interference from the proposed subscriber downlink to the ORBCOMM subscriber downlink.

In all but one of the scenarios, the C/I ratio was either negative or low enough to make the link useless. The exception that produced a positive ratio was where the interfere used CDMA modulation. The results are presented in Tables A2-1 and A2-2.

Three inputs bear special mention: the antenna gain, elevation angle of interferor relative to the ORBCOMM receiver, and how the difference in bandwidths was handled. The antenna gains were taken from the applicant's link budgets and any antenna patterns that were available. The assumed values are given in Table A2-3. In general, near maximum gains were used. The antenna gain is, of course, related to the angle of elevation. In most cases the antenna gain probably does not vary, with changes in elevation angle, as fast as the free space loss, consequently, the angle of elevation can cause a large difference in the amount of interference. In general, the elevation angle on the interfering signal path was assumed to be 60°. This was an attempt to obtain a compromise between a worst case scenario of the rare case of a near-direct fly over and a limb pass. No excess path loss was added into the interfering signal's path.

Account was taken of the different interfering and desired signal bandwidths of the systems with the use of a bandwidth factor. This factor assumes that if the bandwidth of the interferor is less than the ORBCOMM bandwidth, then the power total power of a single interferon is received. Consequently, if the interfering bandwidth is larger then that of the ORBCOMM link than only a portions of the interfering power is received.

TABLE A2-1 DOWNLINK ANALYSIS 137-138 MHz

Performance Factor	Satellite System						
	CTA	VITA			E-SAT		
	Mobile	Fixed	Field	Field-Gateway	DCC	Remote	Remote-Gateway
Modulation type	OQPSK	FSK	FSK	FSK	CDMA	CDMA	CDMA
Data rate (kbps)	19.2	38.4/19.2	9.6	9.6	1041	1	1
signal bandwidth (kHz)	16.4	65/38.4	19.2	19.2			
Polarization	RHC & LHC	RHC	RHC	RHC	LHC		
Transmitter output power (dBW)	13.98	7.00	7.00	7.00	3.00	3.00	3.00
Transmitter Line Losses (dB)	0	0	0	0	0.5	0.5	0.5
Transmitter antenna gain (dBi)	4.9	0	0	0	1.2	1.2	1.2
Transmitter EIRP (dBW)	18.88	7.00	7.00	7.00	3.70	3.70	3.70
Earth Station Antenna Elevation Angle	55	60	60	60	60	60	60
Satellite Altitude (km)	1000	800	800	800	1262	1262	1262
Free space loss (dB)	136.7	134.4	134.4	134.4	138.3	138.3	138.3
Excess path loss incl fading, rain, etc. (dB)	0	0	0	0	0	0	0
Receiver antenna gain (dBi)	-4	-4	-4	15	-4	-4	15
Receiver Line Loss (dB)	0	0	0	0	0	0	0
Polarization mismatch loss (dB)	0	0	0	0	0	0	0
Received signal power (dBW)	-121.8	-131.4	-131.4	-112.4	-138.6	-138.6	-119.6
Transmitted Bandwidth (kHz)	16.4	38.4	19.2	19.2	1041	1000	1000
Receiver Bandwidth (kHz)	4.8	57.6	4.8	57.6	57.6	4.8	57.6
Energy in receiver bandwidth (dBW)	-127.2	-129.6	-137.4	-107.6	-151.2	-161.8	-132.0
Receiver system noise temperature (K)	724	955	724	724	955	724	724
Receiver noise spectral density (dBW/Hz)	-200	-198.8	-200	-200	-198.8	-200	-200
ORBCOMM Carrier Power[1]	-143.8	-127.8	-143.8	-127.8	-127.8	-143.8	-127.8
Received Interference Power	-127.1	-129.6	-137.4	-107.6	-148.1	-159.4	-131.9
C/I	-16.7	1.8	-6.4	-20.2	20.3	15.6	4.1

[1] Based on ORBCOMM Amended Application Link Budgets

TABLE A2-1 (con't) DOWNLINK ANALYSIS 137-138 MHz

Downlink Analysis - 137-138 MHz	Satellite System	
	Final Analysis	LEO-ONE
	RT / MT	Transceiver
Performance Factor		
Modulation type	OQPSK/GMSK	
Data rate (kbps)	9.6	24
signal bandwidth (kHz)	14.4	19.1
Polarization		RHC
Transmitter output power (dBW)	10.00	14.00
Transmission Line Losses (dB)	0.2	0
Transmitter antenna gain (dBi)	-1	0
Transmitter EIRP (dBW)	8.80	14.00
Earth Station Antenna Elevation Angle	60	60
Satellite Altitude (km)	1000	950
Free space loss (dB)	136.3	135.9
Excess path loss incl fading, rain, etc. (dB)	0	0
Receiver antenna gain (dBi)	-4	-4
Receiver Line Loss (dB)	0	0
Polarization mismatch loss (dB)	0	0
Received signal power (dBW)	-131.5	-125.9
Transmitted Bandwidth (kHz)	14.4	19.1
Receiver Bandwidth (kHz)	4.8	4.8
Power in receiver bandwidth (dBW)	-136.3	-131.9
Receiver system noise temperature (K)	724	724
Receiver noise spectral density (dBW/Hz)	-200	-200
ORBCOMM Carrier Power	-143.8	-142.8
Received Interference Power	-136.3	-131.9
C/I	-7.5	-10.9

TABLE A2-2 UPLINK ANALYSIS 148 -150.05 MHz

Performance Factor	Satellite System					
	CTA		VITA		E-SAT	
	Gatewy	Mobile	Fixed	Field	DCC	Remote
Modulation type	OQPSK	OQPSK	FSK	FSK	CDMA	CDMA
Data rate (kbps)	50	2.4 - 4.8	19.2	9.6	1	0.1
signal bandwidth (kHz)	42.8	4.1/2.1	38.4	19.2		
Polarization	RHC	Vertical	RHC	RHC	RHC	RHC
Transmitter output power (dBW)	10.0	7.0	26.6	16.6	7.0	7.0
Transmitter Line Losses (dB)	0	0	0	0	0	0
Transmitter antenna gain (dBi)	16.3	-0.7	0	0	11	2
Transmitter EIRP (dBW)	26.3	6.3	26.6	16.6	18.0	9.0
Earth Station Antenna Elevation Angle	89	60	60	60	60	60
Receiver Altitude (km)	775	775	775	775	775	775
Free space loss (dB)	133.8	134.8	134.1	134.1	134.8	134.8
Excess path loss incl fading, rain, etc. (dB)	0	0	0	0	0	0
Receiver antenna gain (dBi)	1.0	3.6	1.0	3.6	1.0	3.6
Receiver Line Loss (dB)	-1.4	-2.3	-1.4	-2.3	-1.4	-2.3
Polarization mismatch loss (dB)	0	0	0	0	0	0
Received signal power (dBW)	-103.9	-125.0	-104.0	-114.0	-113.3	-122.3
Transmitted Bandwidth (kHz)	42.8	2.1	38.4	19.2	1000	1000
Receiver Bandwidth (kHz)	57.6	2.4	57.6	2.4	57.6	2.4
Power in receiver bandwidth (dBW)	-103.9	-127.2	-107.9	-123.0	-125.7	-148.5
Receiver system noise temperature (K)	1950	537	1950	537	1950	537
Receiver noise spectral density (dBW/Hz)	-195.7	-201.3	-195.7	-201.3	-195.7	-201.3
ORBCOMM Carrier Power	-112.0	-148.6	-112.0	-148.6	-112.0	-148.6
Received Interference Power	-103.9	-127.2	-107.9	-123.0	-125.7	-148.5
C/I	-8.1	-21.4	-4.1	-24.9	12.7	0.6

TABLE A2-2 (con't) UPLINK ANALYSIS 148 -150.05 MHz

Performance Factor	Satellite System					
	Final Analysis		GE Americom		LEO-ONE	
	GS	RT / MT	DCC	Ground	Gateway	Mobile
Modulation type	OQPSK	OQPSK/GMSK	GMSK	GMSK	OQPSK	OQPSK
Data rate (kbps)	54	19.2 / 9.6	9.6	2.4	50	9.6
signal bandwidth (kHz)	36	14.4			42.8	8.2
Polarization	RHC			Linear	RHC	Vertical
Transmitter output power (dBW)	13.00	10.00	14.77	10.00	0.79	8.45
Transmitter Line Losses (dB)	1	0.2	0	0	0	0
Transmitter antenna gain (dBi)	10	0	10	0	16	0
Transmitter EIRP (dBW)	22.00	9.80	24.77	10.00	16.79	8.45
Earth Station Antenna Elevation Angle	60	60	60	60	60	60
Receiver Altitude (km)	775	775	775	775	775	775
Free space loss (dB)	134.8	134.8	134.8	134.8	134.8	134.8
Excess path loss incl fading, rain, etc. (dB)	0	0	0	0	0	0
Receiver antenna gain (dBi)	1.0	3.6	1.0	3.6	1.0	3.6
Receiver Line Loss (dB)	-1.4	-2.3	-1.4	-2.3	-1.4	-2.3
Polarization mismatch loss (dB)	0	0	0	0	0	0
Received signal power (dBW)	-113.2	-123.7	-110.4	-123.5	-118.4	-125.1
Transmitted Bandwidth (kHz)	36	14.4	13.2	7.8	42.8	8.2
Receiver Bandwidth (kHz)	57.6	2.4	57.6	2.4	57.6	2.4
Energy in receiver bandwidth (dBW)	-113.2	-131.5	-110.4	-128.6	-118.4	-130.1
Receiver system noise temperature (K)	1950	537	1950	537	1950	537
Receiver Noise density (dBW/Hz)	-195.7	-201.3	-195.7	-201.3	-195.7	-201.3
ORBCOMM Carrier Power	-112.0	-148.6	-112.0	-148.6	-112.0	-148.6
Received Interference Power	-113.2	-131.5	-110.4	-128.6	-118.4	-130.4
C/I	-1.2	-17.1	-1.6	-20.0	6.4	-18.2

TABLE A2-3 - ASSUMED ANTENNA PARAMETERS USED IN THE ANALYSIS

Uplink	Antenna Type	Antenna Gain (dBi)	Antenna Pattern
CTA			
Gateway	dish	17/16.3	
Subscriber		- 0.7	
Vitasat			
Gateway	Yagi/helix	14	tracking
Subscriber	fixed	0	2.5
E-Sat			
Gateway	dish	11	
Subscriber	omni	2	omni
Final Analysis			
Gateway		10	
Subscriber		0	
GE American			
Gateway	Yagi	10	steerable
Subscriber		0	hemisph.
Leo 1			
Gateway	dish	16	tracking
Subscriber	omni	0	max @ 0_ null @ 90_

Downlink	Antenna Type	Antenna Gain (dBi)	Antenna Pattern
CTA			
Subscriber	quadrifilar	4.9	hemisp. 1 @ nadir 4.9 @ 58_
VITA			
Fixed		3	omni within 1 to 2 dB
Field		3	omni
E-SAT			
DCC	dish	1.2	
Remote		1.2	
Final Analysis			
Subscriber		3	3 dBi @ 5_ -9.5 dBi @ nadir
LEO-ONE			
Subscriber		5.7 dBi	5.7 @ 60_

Engineering Certificate

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

Dated this 24th day of February, 1995

By: [signature]

Paul A. Locke
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CERTIFICATE OF SERVICE

I, Katherine H. Rasdorf, hereby certify that the foregoing ORBCOMM Comments on the second processing round applications was served by first-class mail, postage prepaid, this 24th day of February, 1995 on the following persons:

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