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Satellite Policy Branch
International Bureau

November 4, 1997

7-SAT-AMEND-98

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222, Stop Code 1170
Washington, D.C. 20554

Re: *Erratum to Amendment to Application of Final Analysis Communication Services, Inc. for Authority to Construct, Launch and Operate a Low Earth Orbit Satellite System (File No. 25-SAT-P/LA-95), Filed on October 30, 1997*

Dear Mr. Caton:

Pursuant to Section 25.110 of the Commission's rules, 47 C.F.R. § 25.110, Final Analysis Communication Services, Inc. ("Final Analysis"), by its attorneys, hereby submits this erratum to the above-referenced amendment to its application ("Amendment"). As described below, enclosed are selected pages from the Amendment that correct certain typographical errors or inadvertent oversights in the identified portions of the text, charts and illustrations of the Amendment. In addition, it has come to Final Analysis's attention that certain pages of the Amendment, as specified below, may have been inadvertently omitted from some service copies in the duplication process although these pages are included in the duplicate copy of the Amendment "stamped-in" by the FCC Mellon Bank. Accordingly, out of an abundance of caution, Final Analysis also submits herewith those pages that may have been inadvertently omitted from some service copies.

The following is a list of the corrected pages of the Amendment and pages that may have been inadvertently omitted from some service copies and are being resubmitted herewith.

Table of Contents -- corrected pagination and lettering of headings;
p.8 - corrected heading and footnote cross-reference;

DC01/BATAP/52850.41

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p.8 - corrected heading and footnote cross-reference;

pp.15-16 - Figure II-2 Constellation Orbital Parameters -- corrected table entries;
p.18 - Figure II-3 Final Analysis Constellation Footprint Coverage -- corrected illustration;
p.33 - Figure II-9 Service Downlink (400-401 MHz) -- corrected table entries;
p.34 - Figure II-10 Service Uplink (148-149.81 MHz) -- corrected table entries;
p.36 - Figure II-12 Feeder Downlink (137-138 MHz) -- page possibly inadvertently omitted from some service copies;
p.37 - Figure II-13 Service Downlink (137-138 MHz) -- corrected table entries;
p.43 - Figure II-17 Attitude Control Subsystem Block Diagram -- diagram inadvertently omitted from Amendment;
p.44 - text inadvertently omitted from Amendment due to word processing malfunction;
p.46 - Figure II-18 RAD 6000 Illustration -- corrected illustration;
p.48 - corrected subheading lettering;
pp.52-53 - corrected subheading lettering;
pp.56-57 - pages possibly inadvertently omitted from some service copies.

The corrected text is identified in underlining. Please associate a copy of the enclosed corrections with the Commission's files for Final Analysis's Amendment.

In accordance with Section 25.110 of the Rules, an original and nine (9) copies of this erratum are included herewith. Please acknowledge receipt of this filing on the "stamp-and-return" copy provided for that purpose. Please do not hesitate to call the undersigned counsel at the above-referenced number if you should have any questions regarding this matter.

Respectfully submitted,

Peter A. Batacan
Counsel to Final Analysis Communication Services, Inc.

Enclosures
cc: Attached certificate of service list

DC01/BATAP/52850.41

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LEO services is scarce.[15] In adopting the frequency plan put forth in the Joint Proposal, including in particular the first priority for System 2 to apply for Supplemental Spectrum,[16] the Commission expressed the expectation that such scarce spectrum will be utilized by System 2 to implement one of three "large systems providing a wide array of Little LEO services" to promote "consumer choice, rapid service deployment and lower prices for consumers."[17] As described herein, even with access to future Supplemental Spectrum, the achievement of such spectrum efficiency and the ability to meet the Commissions public policy goal of licensing an additional NVNGMSS Company which will operate a large system in competition with first round licenses, is dependent upon a constellation design that maximizes system availability. Thus, to the extent timesharing requirements diminish the availability of Final Analysis's constellation, system design modifications are required to achieve the market results the Commission has stated it intends to achieve by awarding a System 2 license.

B. Space Segment

1. Constellation Design

The two major impacts discussed above led Final Analysis to perform several complex studies aimed at minimizing the frequency conflicts and outages that will be caused by the time-sharing requirement. Specifically, Final Analysis studied the impact of the following factors, among others, to determine the necessary modifications to its constellation design: (i) inclination of the orbital planes; (ii) coverage outage experienced by the constellation; (iii) the requirement

---

[15] *See Report and Order* at ¶ 133.

[16] *See* discussion in Section III.D below.

[17] *See Report and Order* at ¶ 35.

Figure II-2 Constellation Orbital Parameters

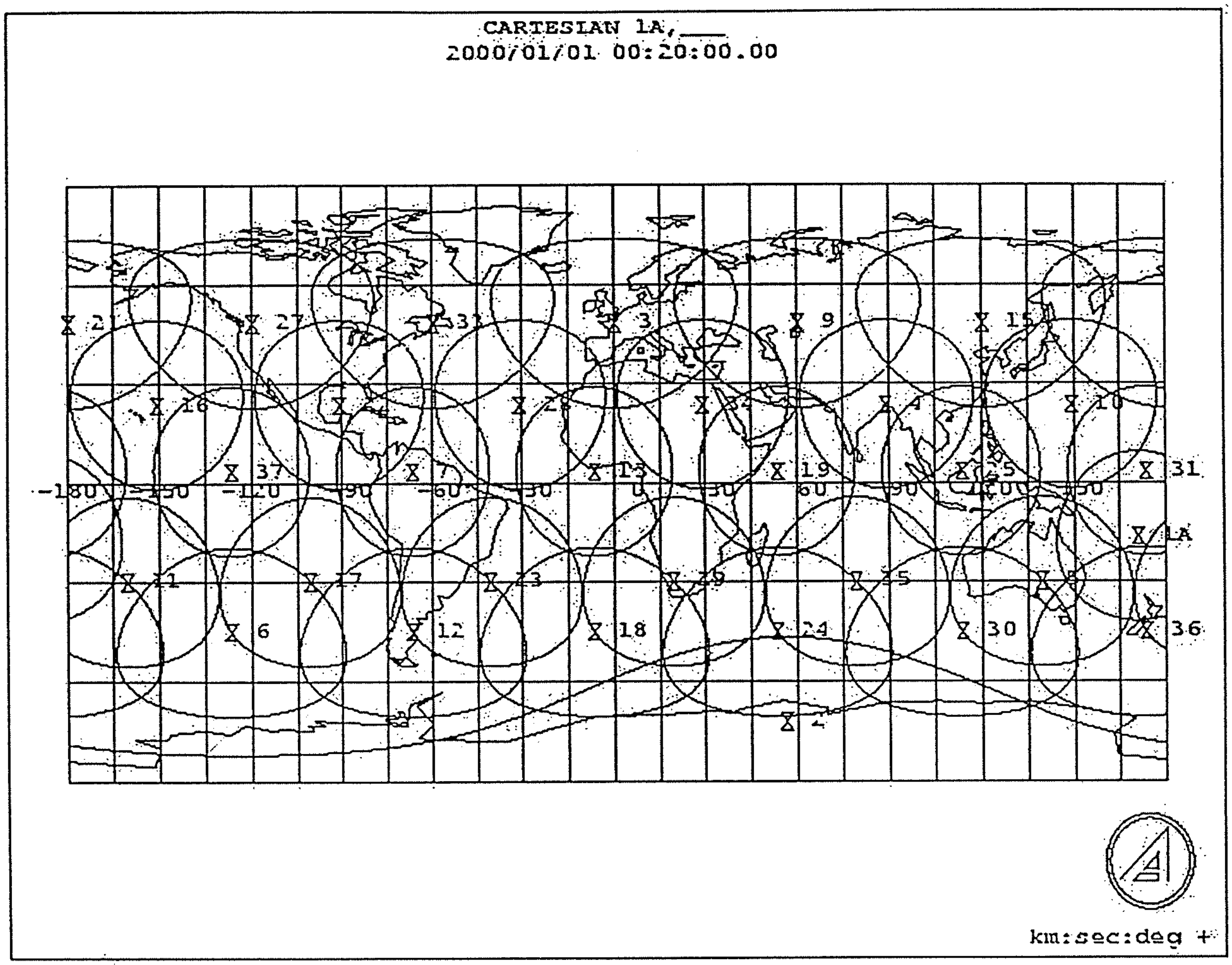
Sa No	Alt (km)	Inc (Deg	Ecc (Deg)	Arg (Deg	Ra (Deg)	M (Deg)	S (Deg
1A	1000.	83	0	0	0	0	360
2	1000.	83	0	0	90	90	360
3	1000.	51	0	0	0	0	360
4	1000.	51	0	0	0	72	360
5	1000.	51	0	0	0	144	360
6	1000.	51	0	0	0	216	360
7	1000.	51	0	0	0	288	360
8*	1000.	51	0	0	0	0	360
9	1000.	51	0	0	60	0	360
10	1000.	51	0	0	60	72	360
11	1000.	51	0	0	60	144	360
12	1000.	51	0	0	60	216	360
13	1000.	51	0	0	60	288	360
14*	1000.	51	0	0	60	0	360
15	1000.	51	0	0	120	0	360
16	1000.	51	0	0	120	72	360
17	1000.	51	0	0	120	144	360
18	1000.	51	0	0	120	216	360
19	1000.	51	0	0	120	288	360

Sa No	Alt (km)	Inc (Deg	Ecc (Deg)	Arg (Deg	Ra (Deg)	M (Deg)	S (Deg
20*	1000.	51	0	0	120	0	360
21	1000.	51	0	0	180	0	360
22	1000.	51	0	0	180	72	360
23	1000.	51	0	0	180	144	360
24	1000.	51	0	0	180	216	360
25	1000.	51	0	0	180	288	360
26*	1000.	51	0	0	180	0	360
27	1000.	51	0	0	240	0	360
28	1000.	51	0	0	240	72	360
29	1000.	51	0	0	240	144	360
30	1000.	51	0	0	240	216	360
31	1000.	51	0	0	240	288	360
32*	1000.	51	0	0	240	0	360
33	1000.	51	0	0	300	0	360
34	1000.	51	0	0	300	72	360
35	1000.	51	0	0	300	144	360
36	1000.	51	0	0	300	216	360
37	1000.	51	0	0	300	288	360
38*	1000.	51	0	0	300	0	360

Abbreviations: Alt=Altitude Ecc=Eccentricity M=Mean Anomaly
Inc=Inclination ArgP=Argument of Perigee S=Service Arc
Ra=Right Ascension of the Ascending Node

*The following satellite numbers represent spares: 8, 14, 20, 26, 32, and 38.

***Figure II-3 Final Analysis Constellation Footprint Coverage**



*This chart shows the footprints of five operational satellites per plane, with the spare satellite occupying the same footprint as the first satellite in each plane.

2. Technical Description of Spacecraft

With regard to feeder links, as System 2 allows, we will operate in 150-150.05 MHz band. The center frequency would be 150.025 with data rate of 28 kpbs and designator of 50K0F1D.

c. Link Analysis

The link margin and analysis results for the various uplinks and downlinks are shown in the following figures.

Figure II-9
Service Downlink (400-401 MHz)

Frequency (Typical)	400.528 MHz
Transmitter Power	32 W
Transmitter Power	15 dBW
Transmitter Line Loss	-0.2 dB
Transmitter Antenna Gain	3.0 dBi
EIRP	17.8 dBW
EIRP dB(W/4kHz)	13.3 dBW
Slant Range	3194.5 km
Space Loss	-154.5 dB
Polarization Loss	-0.5 dB
Atmospheric Loss	-1.0 dB
Receive Antenna Gain	0 dBi
System Noise Temperature	505 K
Data Rate	19,200 bps
Eb/No	20.6 dB
Bit Error Rate (BER)	1E-5
Required Eb/No	13.5 dB
Implementation Loss	-2.0 dB
Margin	5.1 dB
PFD dB(W/m^2/4kHz)	-127.8 dBW

Figure II-10
Service Uplink (148-149.81 MHz)

Frequency (Typical)	149 MHz
Transmitter Power	20 W
Transmitter Power	13 dBW
Transmitter Line Loss	-0.2 dB
Transmitter Antenna Gain	0 dBi
EIRP	12.8 dBW
Slant Range	3194.5 km
Space Loss	-145.9 dB
Polarization Loss	-3.0 dB
Atmospheric Loss	-1.0 dB
Receive Antenna Gain	3.0 dBi
System Noise Temperature	940 K
Data Rate	9600 bps
Eb/No	24.9 dB
Bit Error Rate (BER)	1E-05
Required Eb/No	13.5 dB
Implementation Loss	-2.0 dB
Margin	9.4 dB

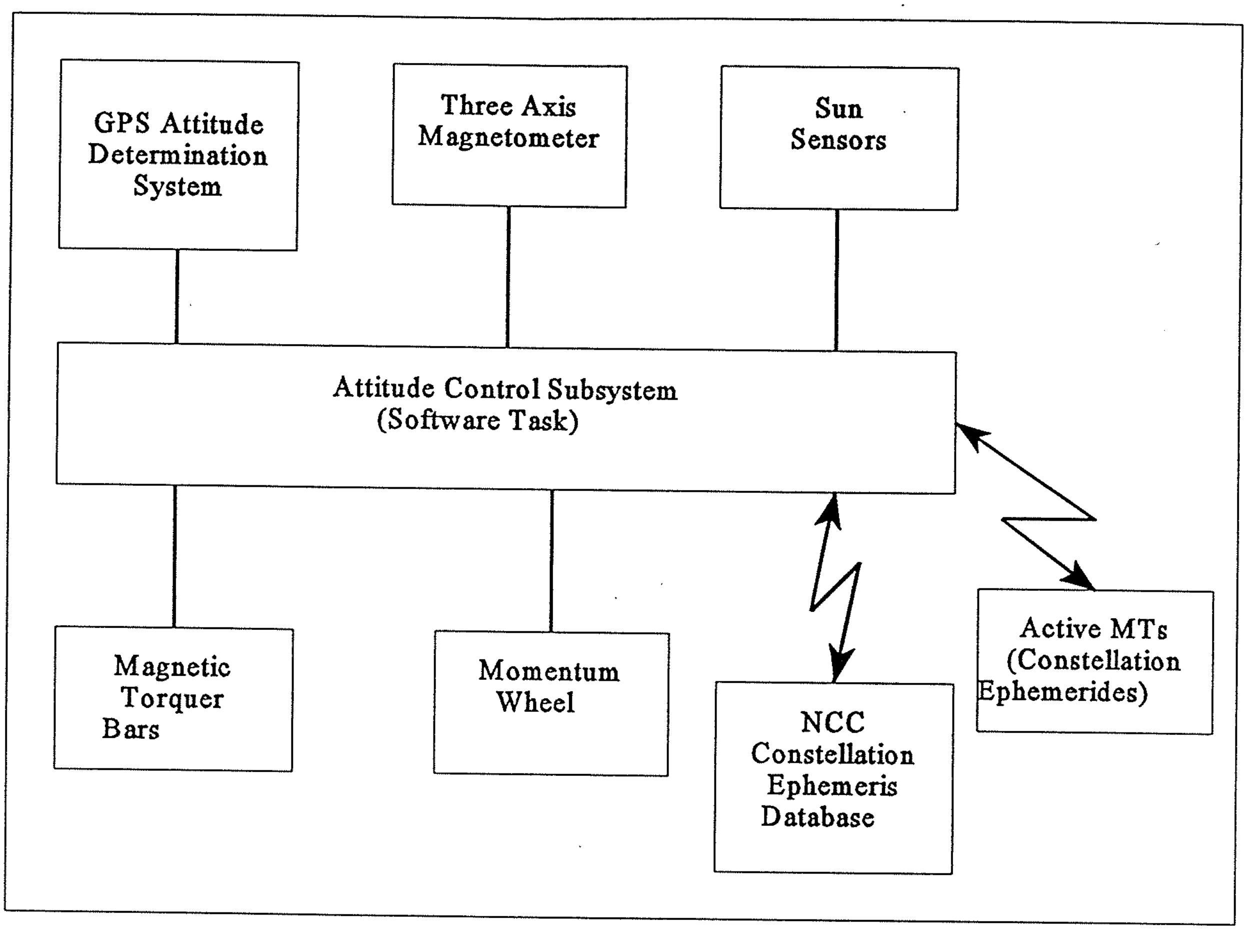
Figure II-12
Feeder Downlink (137-138 MHz)

Frequency (Typical)	137.9125 MHz
Transmitter Power	32 W
Transmitter Power	15 dBW
Transmitter Line Loss	-0.2 dB
Transmitter Antenna Gain	3.0 dBi
EIRP	17.8 dBW
Slant Range	3194.5 km
Space Loss	-145.3 dB
Polarization Loss	-0.5 dB
Atmospheric Loss	-1.0 dB
Receive Antenna Gain	12 dBi
System Noise Temperature	1565 K
Data Rate	112,000 bps
Eb/No	29.2 dB
Bit Error Rate (BER)	1E-05
Required Eb/No	13.5 dB
Implementation Loss	-2.0 dB
Margin	13.7 dB

Figure II-13
Service Downlink (137-138 MHz)

Frequency (Typical)	137.528 MHz
Transmitter Power	32 dBW
Transmitter Power	15 dBW
Transmitter Line Loss	-0.2 dB
Transmitter Antenna Gain	3.0 dBi
EIRP	17.8 dBW
EIRP dB(W/m²/4kHz)	14.85dBW
Slant Range	3194.5 km
Space Loss	-145.2 dB
Polarization Loss	-3.0 dB
Atmospheric Loss	-1.0 dB
Receive Antenna Gain	0.0 dBi
System Noise Temperature	1565 K
Data Rate	9600 bps
Eb/No	25.4 dB
Bit Error Rate (BER)	1E-05
Required Eb/No	13.5 dB
Implementation Loss	-2.0 dB
Margin	9.9 dB
PFD dB (W/m²/4kHz)	-126.2 dB

Figure II-17 Attitude Control Subsystem Block Diagram



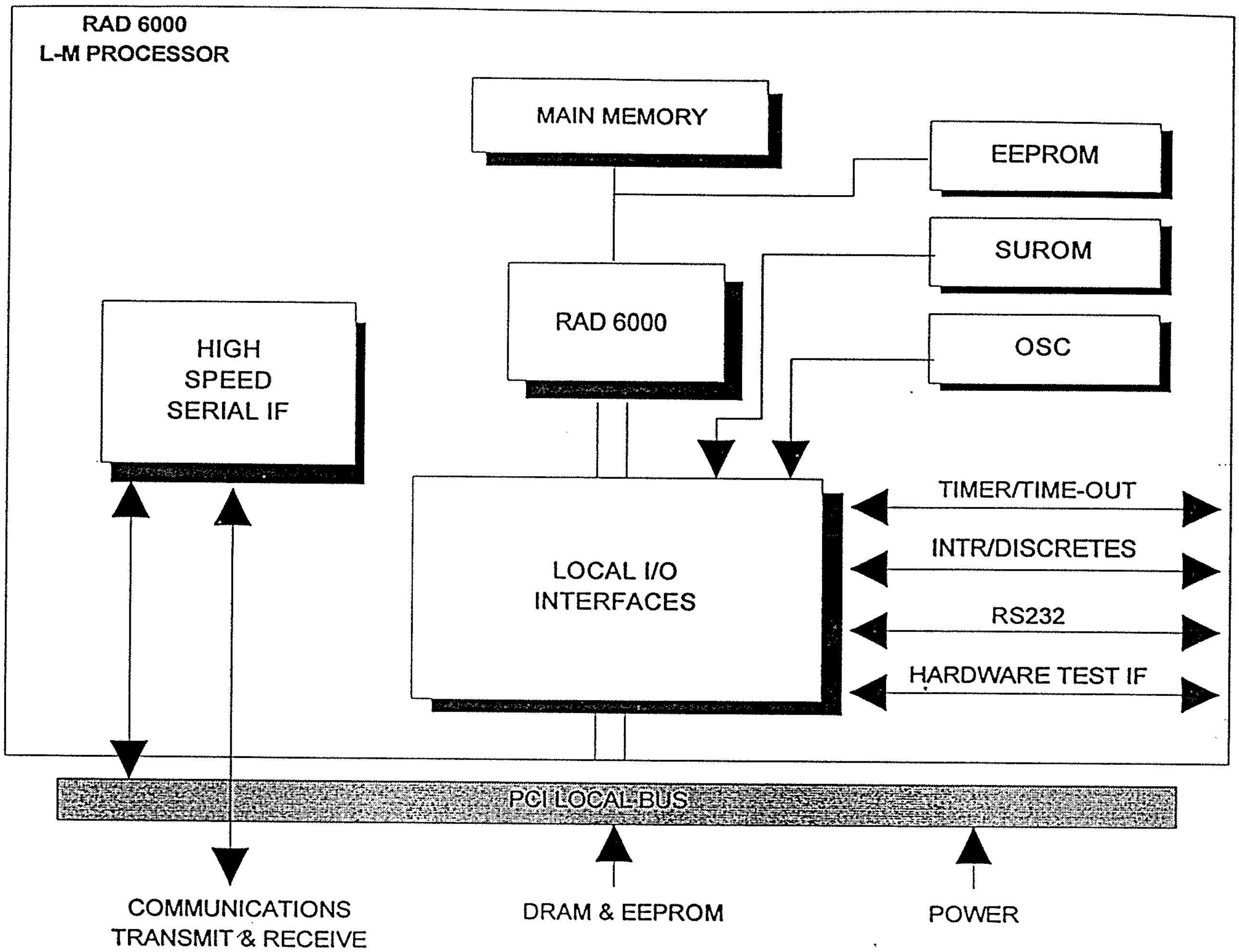
The sun sensor will be located on a deployed solar array panel on one side of the satellite, as close as practical to the panel axis centerline. Backup sensors will be a single three (3) axis magnetometer and a redundant sun sensor located on the deployed solar array panel on the opposite side of the satellite.

The control elements consist of three (3) mutually perpendicular magnetic torquer bars (MTB) and a single momentum wheel aligned to provide torque about the satellite's yaw axis. The MTBs will be capable of generating a magnetic dipole of 10 amp-meters^2 each, and will be controlled by three (3) independent proportional current sources. As such, the MTBs effectively form a doubly redundant control system, and will provide a secondary function of shedding excess momentum developed by the MW and SADM. Although the spacecraft will utilize the momentum wheel for fine pointing control about the yaw axis ($\pm 2^\circ$) to optimize solar array performance, the MTBs and ACS software will be capable of providing sufficient control about the yaw axis to meet the power needs of the primary communications mission of the satellite.

Due to the conservative nature and redundant design of the ACS sensors and control elements, this system conforms well with the planned 7 year lifetime of the satellite. The satellite will calculate the orbital elements from data provided by the GPSADS to support on board operation, and will regularly compare its ephemeris with the constellation database maintained by the NCC. The NCC will provide satellite ephemeridae to each unit and will update the global MT positions of each active MT upon being contacted by the MT.

Two orbital maintenance systems are being considered for use onboard the FAISAT spacecraft. The primary system will be a cold gas propulsion system utilizing flight proven hardware employed on many spacecraft to date. The cold gas system will be capable of providing the necessary velocity increments (delta V) to correct for orbit insertion errors, to initially space the satellites with respect to each other in each of the six planes, to maintain the

Figure II-18 RAD 6000 Illustration



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in and qualification tests are performed, and where necessary, additional radiation packaging protection is provided.

C. Ground Components

The ground components of the Final Analysis system consist of the NCC and MGS in Lanham, Maryland, the back up MGS in Logan, Utah, and the SGS in Andoya, Norway.

The Final Analysis system services two types of users. Each type of user employs a transceiver ground terminal. The passive user which only collects data will use a RT to collect those data. The operation of the RT is described below. The interactive user will employ a Message Terminal (MT) with an alphanumeric keyboard to create messages and interact with the satellite. This protocol and strategy is also described in the following paragraphs.

1. Network Control Center

The NCC will be located in the Final Analysis corporate headquarters in Lanham, Maryland. The NCC will operate in a receive only mode and operators will command the satellite system via internet or telephone lines to the ground stations. Technical operations and ephemeris determinations will be performed in the NCC. Location and interrogation schedules of RTs and MTs will also be maintained in the NCC.

2. Master Ground Station

Ground control of the satellite will be performed at the MGS located in Lanham, Maryland. This is the primary facility to perform the tracking, telemetry, and control functions for the satellites. Separate channels on the satellite allow communications between the ground station and the satellite while the satellite is gathering data. Information such as polling lists for the RTs and any messages for MTs are uploaded to the satellite. Command and control functions such as telemetry requests, system software patches and tests, and spacecraft subsystem monitoring are also conducted. Attitude control software onboard will control the attitude by

III. Interference and Frequency Sharing Analysis

A. 148-150.05 MHz Uplink Band

1. 148-149.9 MHz Band

The spectrum made available to System 2 in the 148-149.9 MHz band is discussed in the *Report and Order* at ¶ 32. Limitations in this band are governed by footnote 608a which states that the NVNG service shall not constrain the development and use of fixed, mobile, and space operation services in this band. Final Analysis proposes using 148-148.25 MHz, 148.75 - 148.855 MHz, 148.955 - 149.585 MHz, 149.635 - 149.81 MHz for global service uplink and 148.855 - 148.905 MHz within CONUS and globally for service links if System 3 does not use the band for feeder links. If S80 does not use the band 148.905 - 148.955 MHz for feeder links, this band may be used by System 2 for service uplink.

(a) Protection of Existing Services

Concerning protection of existing fixed and mobile user services, protection will be accomplished by adhering to Footnotes US 323 and Footnote 608, 608a, 608b, and 608c.

Final Analysis designed its service uplink communication system to utilize the Scanning Activity Receiver System (STARS) to avoid interference with fixed and mobile users of this band. In operation, the STARS receiver onboard the satellite will scan this band in 2.5 kHz steps and identify unused channels. These unused channels will be assigned as uplink frequencies for the RTs and MTs. The STARS system is an enhanced version of DCAAS. The active channel avoidance capability of the Final Analysis STARS system will not permit the assignment of these bands for uplink transmissions when in use by other services or systems. Final Analysis has designed its uplink communications system so that it would not interfere with these users by adhering to Footnote US323, as follows: i) the STARS system will not assign an uplink frequency to a RT or MT that is actively being used by fixed or mobile users, ii) the modified Time Division Multiple Access (TDMA) polling scheme will limit transmissions to no more than 17% of the time during any 15 minute period and will limit the uplink message size such that a single transmission will not exceed 450 miliseconds, and iii) software in the RTs and MTs will not allow immediate, consecutive transmissions on a single frequency.

(b) Sharing with VITA

Final Analysis will not operate in the VITA band 149.81 - 149.9 MHz.

(c) Sharing with System 1 and ORBCOMM

In the bands shared with System 1 and ORBCOMM, the STARS system will prevent assignment of spectrum in use by other NVNG systems.

(d) Sharing with System 3 and S80

System 2 overlaps its service uplink operation with System 3 and S80 in the bands 148 - 148.25 MHz, 148.75 - 148.905 MHz. The two edge bands 148.0 - 148.25 MHz and 148.75 - 148.855 will not cause harmful interference to CDMA operations. System 3 indicated that it will not perform feeder link operations within CONUS. Therefore, the use of the band 148.855 - 148.905 MHz within CONUS should not cause any harmful interference to System 3 feeder uplink operations. The band 148.905 - 148.955 MHz has been set aside for S80 feeder uplink operations. CONUS service uplink operation in this band should be feasible. If so, then System 2 could perform continuous STARS service uplink operations from 148.75 to 149.585 MHz.

2. 149.9 - 150.05 MHz Uplink Band

System 2 utilizes the 150 - 150.05 MHz band for its feeder uplink operations. This is a portion of the 149.9 - 150.05 MHz Transit band which was allocated to NVNG-MSS on a co-primary basis by the FCC in 1993. Final Analysis will time share the use of this band with the Russian Meteor system which uses the band for downlink, whereas Final Analysis will use the band for uplink services. Interference avoidance with the Meteor shall be effected by one or more of the following methods: 1) maintaining a coordination distance from navigable waterways; 2) limiting minimum elevation angle with azimuth toward navigable waterways; or

Final Analysis will transition the majority of its feeder link operations for the NOAA bands to the NOAA channels, as NOAA migrates to the NOAA bands with the installation in orbit of the Metsat constellation in the 2003 to 2006 period.

System 2 will time-share with NOAA channels 137.333-137.367 MHz, 137.475-137.525 MHz, 137.595-137.645 MHz and 137.753-137.787 MHz on a secondary basis for feeder link services until 2000 and on a co-primary basis thereafter. During the 2006 and 2009 time period it is expected that NOAA will vacate the two NOAA channels, 137.485-137.515 MHz and 137.605-137.635 MHz which are called the APT channels. NOAA has expressed a continuing need for transmission of data in the NOAA TIP channels 137.333-137.367 MHz and 137.753-137.787 MHz, until the year 2012. System 2 will have time-shared use of the four NOAA channels until between 2006 and 2009. Time-sharing with the two NOAA TIP channels will continue until approximately 2012. Thereafter time-sharing between System 2 and the NOAA channels will not be required and System 2 will operate in these channels along with other primary allocated services.

As suggested by the *Report and Order*, Final Analysis will protect NOAA's APT & TIP channels based on an elevation angle of 5°. Furthermore, with regard to the NOAA bands 137.025-137.175 MHz and 137.825.825-138 MHz, the Report and Order suggests non-interference to NOAA satellites based on an elevation angle of 0°. Final Analysis strongly believes a 5° elevation angle is adequate. However, to demonstrate our compliance with the Report and Order we will accept a 0° elevation angle.

We will accomplish timesharing with NOAA in the following way. Currently we obtain from NORAD electronically the two-line element of the FAISAT-2v[31]. We obtain the NOAA satellite's two line elements from NORAD also. We currently use an SGP4 propagator (which

[31]Final Analysis will develop a strategy with NORAD to prevent "spoofing," most probably by initialing calls itself.

is also used by the U.S. military and NORAD) for tracking our FAISAT-2v satellite and for the orbital parameters and tracks of the NOAA satellites. We have essentially already constructed the timesharing algorithms for determining the outage of the FAISAT satellites when in view of the various NOAA satellites. We are doing these things today, and we will be able to do them in the future without difficulty. Should NORAD in the future change its outage algorithm from SPG4 to a different propagator, our ground control applications software can be refitted with whatever propagator NORAD chooses. In addition with regard to the 72-hour reset requirement, Final Analysis's comments to the NPRM state that our satellite has several layers of protection that would detect a failed-on condition well in advance of 72 hours.

2. Sharing with Meteor

As suggested by the *Report and Order*, Final Analysis will timeshare the 137.367-137.4125 MHz band with the Russian Meteor system. The exact elevation angle and other necessary data will only be known after coordination with Meteor. However, Final Analysis will follow the same steps to accomplish timesharing as described in the section on timesharing with NOAA.

3. Sharing with System 3

The *Report and Order* states that the System 3 operation in this band shall be consistent with the coordination agreements GE Starsys entered into with NOAA, ORBCOMM and the S80 system. In discussions with GE Starsys, Final Analysis has been informed that no agreement has been completed regarding co-operation between NOAA and Starsys. In addition, Starsys indicated the only formal agreement in place is with ORBCOMM.

During the first round negotiated rulemaking, ORBCOMM, Starsys and VITA entered into a sharing plan which concluded that additional systems could be accommodated in this band. Subsequently, ORBCOMM and Starsys agreed on certain technical issues regarding interference

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing Erratum to Amendment to Application of Final Analysis Communication Services, Inc., was sent by hand delivery or mailed, via first-class mail, postage prepaid, this 4th day of November, 1997, to each of the following:

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Washington, D.C. 20554

Commissioner Gloria Tristani*
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* **Hand Delivery**