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

In the Matter of	)	
	)	
FINAL ANALYSIS COMMUNICATION SERVICES, INC.	) File Nos.	7-SAT-AMEND-98;
	)	25-SAT-P/LA-95
Application for Authority to Construct	)	
Launch and Operate a Non-Voice,	)	
Non-Geostationary Mobile Satellite System	)	

To: The Chief, International Bureau

REPLY COMMENTS

Final Analysis Communication Services, Inc. ("Final Analysis"), by its attorneys, hereby submits its reply to the comments filed by Orbital Communications Corporation ("ORBCOMM") on Final Analysis's above-captioned amendment to its application for a non-voice, non-geostationary mobile satellite system ("NVNG MSS" or "Little LEO") license. Final Analysis's amendment conforms its original FAISAT constellation to the band plan and sharing requirements for "System 2" established in the band-sharing agreement entered into by the second round Little LEO applicants (the "Joint Proposal") and the Commission's recently released *Report and Order*. For the reasons discussed below, Final Analysis believes that ORBCOMM's concerns in its comments are being satisfactorily addressed by Final Analysis.

ORBCOMM's comments focus on two concerns: (i) potential out-of-band interference from Final Analysis to ORBCOMM's adjacent channel operations in the 137 MHz downlink band; and (ii) coordination of Final Analysis's co-channel uplink operations in the 148 MHz band.[1] ORBCOMM suggests that these concerns should be addressed before a license

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[1] In this regard, it is important to note that the concerns about Final Analysis's (continued...)

can be issued to Final Analysis. Subsequent to the filing of ORBCOMM's Comments on the Final Analysis Amendment, Final Analysis and ORBCOMM initiated coordination of the issues identified as concerns by ORBCOMM, and as demonstrated by the Joint Letter provided as Attachment A, hereto, both Final Analysis and ORBCOMM are confident that coordination can be successfully concluded. Therefore, ORBCOMM's interference concerns are being addressed and delay in issuance of an NVNG MSS license to Final Analysis thus would not be in the public interest. Specific explanations of how ORBCOMM's concerns are being addressed are discussed below.

I. FINAL ANALYSIS'S ADJACENT DOWNLINK OPERATIONS IN THE 137 MHz BAND ARE BEING COORDINATED WITH ORBCOMM.

ORBCOMM raises concerns regarding the possibility of out-of-band interference to ORBCOMM's operations in the 137-138 MHz band from Final Analysis's adjacent downlink operations. *See* ORBCOMM Comments at 8-9. Specifically, ORBCOMM is concerned that adjacent channel interference may arise due to the proposed increased data rate and power of Final Analysis's downlink transmissions.

Final Analysis's adjacent downlink operations comply with Commission's requirements and do not pose a threat of potential out-of-band harmful interference to ORBCOMM in the 137 MHz band. Final Analysis has begun coordination with ORBCOMM for use of the downlink spectrum. In this coordination meeting, Final Analysis and ORBCOMM

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[1](...continued)
system augmentation and possible increased interference alleged by Leo One in its Petition to Deny Final Analysis's amended application are not a concern to ORBCOMM. Final Analysis finds this lack of concern significant given that ORBCOMM is an existing licensee with extensive experience in designing and launching satellites as well as designing and operating a Little LEO communications system.

discussed at length the details of downlink operations as proposed in the Final Analysis amendment. As can be seen from the attached Final Analysis/ORBCOMM Joint Letter, both companies believe that downlink operations as proposed in Final Analysis's and ORBCOMM's Amendments can be coordinated without any technical difficulties.[2]

Attached hereto as Appendix A is a description of how the characteristics of Final Analysis's downlink transmissions, using GMSK modulation, are such that adjacent channel operations without harmful interference are readily achievable and are well within generally accepted U.S. cellular industry standards (IS-54). Over the past several years Final Analysis has devoted significant time and resources in the development of its GMSK modulation practices which were ultimately implemented and tested in the FAISAT-1 and FAISAT-2v experimental satellites. The result of our R & D program demonstrated that GMSK was by far the superior technology for minimization of out-of-band emissions, and as implemented by Final Analysis produces results well within industry standards. Specifically, the U.S. cellular industry finds acceptable adjacent channel interference of less than 25 dB below carrier power in the adjacent 25 kHz channel. The Final Analysis system, in actual performance tests, produces out-of-band emissions in the 137 MHz and 400 MHz bands 35 dB and 36 dB (respectively) below carrier power, values comfortably in the acceptable range and well within the coordination capabilities of the parties.

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[2] ORBCOMM notes in its October 30, 1997 Amendment on page 4 that it has previously coordinated adjacent channel operations with NOAA, and anticipates also being able to coordinate successfully with System 2 (Final Analysis) with regard to adjacent channel operations.

II. FINAL ANALYSIS'S AND ORBCOMM'S OPERATIONS CAN BE COORDINATED TO AVOID HARMFUL INTERFERENCE IN THE 148 MHz UPLINK BAND.

ORBCOMM is concerned that both Final Analysis's proposed uplink operations in System 2 and Leo One's proposed uplink operations in System 1 may not sufficiently protect ORBCOMM from co-channel interference in the 148 MHz band. It has two specific concerns. First, ORBCOMM questions whether Final Analysis's version of a Dynamic Channel Activity Assignment ("DCAAS")-based system called Scanning Telemetry Activity Receiver System ("STARS") will work to avoid interference[3]. Second, ORBCOMM asserts a primary status for use of subscriber uplinks during periods of reduced channel availability.[4] This would be in contravention of the requirement in the *Report and Order* that licensees will share the available uplink channels. *Id.* at ¶¶ 54-56.

A. Final Analysis's DCAAS System -- STARS -- Can Be Shown To Avoid Harmful Interference.

Final Analysis has proposed to employ its proprietary DCAAS-based STARS to avoid interference to ORBCOMM in the 148 MHz uplink band. *See* Amendment at 52-53. The active channel avoidance capability of the Final Analysis's STARS system will not permit assignment of the 148 MHz uplink bands for uplink transmissions when in use by other services or systems. *See id.*

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[3] As noted by ORBCOMM on page 5 of its October 30, 1997 Amendment, ORBCOMM does not yet know how System 1 (Leo One) and System 2 (Final Analysis) will operate their subscriber uplinks in the 148-149.9 MHz band, but ORBCOMM anticipates that through means such as pre-defined algorithms, it may be possible for Systems 1 and 2 to avoid selection of the same frequencies selected by ORBCOMM.

[4] *See* ORBCOMM Comments at 3-4; *see also* Comments of ORBCOMM on Leo One USA Corporation Amendment.

As discussed in the *Report and Order*, "System 1 and System 2 can operate in this band [148.905 - 149.8] without causing harmful interference into the ORBCOMM system." *Id.* at ¶ 62. The Commission further states that "by employing DCAAS and FDMA transmission techniques, System 1 and System 2 can also use the spectrum efficiently and avoid causing harmful interference into ORBCOMM's uplink transmissions by detecting open channels on which to transmit. *Id.* at ¶ 63 (citing ORBCOMM Comments in IB Docket No. 96-220 at 41). Accordingly, consistent with the sharing parameters established in the *Report and Order*, Final Analysis's uplink operations in the 148 MHz band will employ STARS/DCAAS channel polling techniques to avoid co-channel interference to ORBCOMM.

Through its experimental satellite program, Final Analysis has been continuing to refine its STARS technology, and based on this experience is confident of the robustness, accuracy, and reliability of its STARS systems. The STARS technology is contained in each satellite and operates autonomously with respect to the other satellites in the bands of interest assigned to the system by the Network Control Center ("NCC"). This central control provides the necessary monitoring and control to minimize the occurrence of harmful interference which could be experienced by the overlapping satellites in the constellation. Each satellite scans the relevant portions of the 148-150 MHz band[5] on a periodic basis and collects occupancy data on the bands of interest. The STARS technology scan capability is based on the use of sensitive receivers matched with Fast Fourier Transform ("FFT") scanners which have a frequency resolution of a few Hertz. The result of this scan is used to build a database of channel use over time in order to assess the statistical probability of channel occupancy. This data base is used

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[5] The STARS technology can scan several UHF and VHF bands, with resolution from a few Hertz to several megahertz.

to make a frequency assignment to a series of remote terminals ("MESs") which are being instructed to broadcast to the satellite the data collected at the remote terminals.

As reported in the ITU-R M.1039-1 (FN Appendix 1 to Annex 1 Para. 4), ORBCOMM has collected substantial data regarding sharing of the 148.0-149-9 MHz band using ORBCOMM test satellites (Communications Demonstration Satellites ("CDS")). The result of this experimental program demonstrates that sharing without harmful interference is statistically predictable and supports the efficacy of the DCAAS strategy on which STARS is based.

The Final Analysis STARS technology was designed to permit the FAISAT constellation to optimize its ability to operate on frequencies below 1 GHz on a co-frequency basis with terrestrial services such as fixed and mobile users. The question of merging the channel survey and selection methods of the three operators, ORBCOMM, Leo One, and Final Analysis, poses a challenge which can be managed with study and coordination. We agree with ORBCOMM that there may be some specialized algorithms which may be utilized to mitigate any operational overlap problems in the utilization of the subject band. As previously noted, Final Analysis and ORBCOMM have started coordination discussions, and both parties have discussed the need to examine each company's interference avoidance scanning methodology. Both companies have expressed confidence in their systems.

Detailed information to verify how Final Analysis's proprietary STARS technology and ORBCOMM's proprietary DCAAS system will work to preclude mutual interference must be considered in such a way that does not require disclosure of proprietary or commercially sensitive information. *Cf.* ORBCOMM Petition at 7. Both ORBCOMM's DCAAS system and Final Analysis's STARS technology involves proprietary software. Both companies are thus limited as to the extent they can provide information to the other to verify

the system technical parameters. In order to resolve this problem and provide mutual verification, both companies have initially agreed to explore the appointment of an independent third party to conduct an *in camera* performance review of ORBCOMM's DCAAS software and Final Analysis's STARS software. Such a review would result in either a confirmation that the systems will work as designed, or else will result in an outline of requirements to make the systems work together.[6]

B. Grant of the Full Degree of Protection Requested by ORBCOMM in the 148 MHz Uplink Band Is Not Proper.

ORBCOMM claims that its status as an incumbent authorized Little LEO licensee entitles it to a "standard of protection" whereby subsequent applicants must demonstrate that they will not cause unacceptable interference to ORBCOMM. ORBCOMM Comments at 3-4 (citing 47 C.F.R. § 25.154(a)). In particular, ORBCOMM requests that Final Analysis take steps to avoid harmful interference to ORBCOMM to prevent a "reduced number of open channels" available to ORBCOMM in the 148 MHz band. This may effectively render Final Analysis secondary in operations to ORBCOMM. *Cf.* ORBCOMM Comments at 6. This result would conflict with the co-primary, shared status accorded the System 2 operator (Final Analysis) and ORBCOMM, as agreed in the Joint Proposal and confirmed in the *Report and Order*. Final Analysis does not believe that the level of protection requested by ORBCOMM beyond that already being coordinated is necessary or appropriate.

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[6] Both ORBCOMM and Final Analysis have invested significant resources in the development of their scanning software, and feel that coordination and interference avoidance is technically feasible and not difficult to achieve. However, nothing in the record indicates that Leo One has spent any resources or done any R&D to develop such software, or to identify a vendor that can perform this complex task for it. Final Analysis is therefore concerned as to how Leo One will develop this critical element in a timely fashion.

III. THE FCC SHOULD PROCEED IMMEDIATELY TO LICENSE FINAL ANALYSIS AND NOT WAIT FOR COMPLETION OF COORDINATION WITH ORBCOMM.

In its comments on the Final Analysis Amendment, ORBCOMM asks the Commission to delay licensing of Final Analysis until it completes coordination with ORBCOMM. Final Analysis believes the Commission should proceed with licensing immediately. It should follow the precedent it established in the *ORBCOMM Authorization Order* where it issued a license to ORBCOMM conditioned on ORBCOMM's completion of coordination with NOAA and NTIA prior to launch of the satellites.[7] It should be noted that although ORBCOMM received its license over three years ago, coordination between it and NOAA has yet to be completed, and coordination between ORBCOMM and GE-Starsys took over two years.[8]

According to Final Analysis the same treatment as ORBCOMM is not only fair it also is pro-competitive, and will properly promote the Commission's goal of quickly achieving competition in the Little LEO marketplace. Final Analysis is ready to enter the market immediately upon licensing, unlike the other unlicensed applicants. Final Analysis has invested over $30 million in the development of its system, has built and launched two experimental satellites, began construction of the first two commercial satellites,[9] has developed its prototype

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[7] *See Application of Orbital Communications Corporation*, Order and Authorization, 9 FCC Rcd 6476 at ¶ 35 (1996) ("*ORBCOMM Authorization Order*").

[8] *See, e.g.*, Joint Letter from Stephen D. Baruch, Counsel for STARSYS Global Positioning, Inc., and Stephen L. Goodman, Counsel for ORBCOMM, to Mr. Donald Gips, Acting Chief, International Bureau, FCC, dated June 20, 1996 (resolving outstanding technical issues between ORBCOMM and STARSYS).

[9] The Commission has granted Final Analysis a Section 319(d) waiver to

(continued...)

user terminals, has built three commercial quality ground stations, secured launch services for the entire constellation, and has signed agreements with its Value Added Resellers and National Service Providers. Final Analysis also has in place utility application demonstration contracts and has implemented an International Awareness Program.[10] Delay in licensing Final Analysis until it has completed coordination with its only effective competitor merely gives ORBCOMM the ability to control the timing of Final Analysis's licensing by controlling the pace of coordination discussions. As can be seen from ORBCOMM's own case, coordination discussions can take years to complete, and therefore waiting until completion of coordination before licensing Final Analysis could mean a delay of many years. As ORBCOMM itself has demonstrated, such a delay in licensing is not necessary to ensure proper coordination.

IV. CONCLUSION

Accordingly, for the foregoing reasons, Final Analysis urges the Commission to find that the concerns in ORBCOMM's comments are being sufficiently addressed. Final Analysis is sufficiently addressing ORBCOMM's concerns regarding potential interference issues, and delay in the granting of a System 2 license to Final Analysis would merely serve to

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[9](...continued)
construct the first two commercial satellites in its constellation, and Final Analysis is the only second round Little LEO applicant to receive a Section 319(d) waiver.

[10] By contrast, Leo One has not done any satellite, user terminal, or ground station R & D (indeed it has abandoned its originally planned experimental satellite program); has not contracted with a designer or manufacturer for its satellite, its ground stations, or its user terminals; and has not contracted with a provider of launch services. Therefore, Final Analysis is three to four years ahead of Leo One in readiness to enter the market, and as such, is the only applicant able to achieve the Commission'ss policy goal of providing competition in the Little LEO market during the next few years.

delay the introduction of effective competition to ORBCOMM. Accordingly, Final Analysis urges the Commission to expeditiously grant it an NVNG MSS license.

Respectfully submitted,

FINAL ANALYSIS COMMUNICATION SERVICES, INC.

By: _____

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Dated: December 15, 1997

ATTACHMENT A

JOINT LETTER

December 15, 1997

Ms. Regina Keeney, Chief
International Bureau
Federal Communications Commission
2000 M Street, N.W.
Washington, D.C. 200554

Re: **Applications for Second Round NVNG MSS Licenses: Final Analysis Communication Services, Inc. File Nos. 25-SAT-P/LA-95 and 7-SAT-AMEND-98; and ORBCOMM File Nos. 28-SAT-MP/ML-95 and 194-SAT-ML-97**

Dear Ms. Keeney

This letter is submitted jointly by Final Analysis Communication Services, Inc. ("Final Analysis") and Orbital Communications Corporation ("ORBCOMM") to inform you of discussions conducted last week regarding technical coordination between the two proposed Non-voice Non-geostationary Mobile Satellite Service ("NVNG MSS") systems referenced above.

With respect to coordination on downlink operations in the 137- 138 MHz band, Final Analysis and ORBCOMM have conducted discussions concerning sharing in this band and are satisfied that coordination can be achieved successfully.

In its Comments recently submitted to the Commission on amendments to these applications filed on October 28, 1997, ORBCOMM focused attention on the need to ensure that Final Analysis, ORBCOMM and Leo One USA ("Leo One") will effectively coordinate co-channel uplink operations in the 148 - 150 MHz band. In Reply Comments separately filed contemporaneously with this letter, Final Analysis describes in detail its proprietary Scanning Telemetry Activity Receiver System ("STARS") which it proposes to utilize to avoid interference in this band.

In order to verify that Final Analysis's proprietary STARS system and ORBCOMM's proprietary Dynamic Channel Activity Assignment ("DCAAS") system can operate along side each other to avoid co-channel interference in the 148 - 150 MHz band, ORBCOMM and Final Analysis have discussed and agreed that each company's technology may be reviewed by an independent and confidential source. This approach would protect each company's proprietary interest in the technology while facilitating expeditious resolution of coordination issues.

To the extent that Leo One has developed its own proprietary technology, Final Analysis and ORBCOMM would be agreeable to having it reviewed under the same arrangement.

Sincerely yours,

Aileen A. Pisciotta
Counsel to Final Analysis

Stephen L. Goodman
Counsel to ORBCOMM

APPENDIX A

ADJACENT CHANNEL OUT-OF-BAND EMISSION STUDY

Adjacent Channel Out of Band Emission Study

1. Introduction

Over the past several years Final Analysis has devoted significant time and resources in the development of GMSK modulation practices which were ultimately implemented and tested in the FAISAT-1 and FAISAT2v experimental satellites. The result of our R&D demonstrated that GMSK was by far the superior technology to minimize out of band interference.

Final Analysis has performed analysis, laboratory demonstrations in conjunction with Texas A&M University, laboratory demonstrations at Final Analysis, and measurements of actual flight hardware and subscriber terminals transmitters in order to determine out of band emissions of transmitters using GMSK modulation with a BT=.5. Final Analysis has found that all laboratory demonstrations and measurement of flight hardware have yielded results close to the theoretical calculations which have been performed.

This paper first provides a brief definition of adjacent channel interference used by the U.S. digital cellular Industry (IS-54). This definition is then applied to the Final Analysis system and the results compared with the IS-54 specification for suppression of emissions in the first adjacent band. Without additional information from Little LEO systems that have adjacent frequency assignments, these standards are considered to be a close first order approximation sufficient to demonstrate the feasibility of coordination with other users of the band who are assumed to use a signal-in-space very similar to that used by the U.S. digital cellular FDMA systems.

2. Definition of Adjacent Channel Interference

Adjacent Channel Interference (ACI) is defined as follows:

$$ACI := \frac{\int_{-\infty}^{\infty} G(f)\cdot(|H(f-\Delta f)|)^2\,df}{\int_{-\infty}^{\infty} G(f)\cdot(|H(f)|)^2\,df}$$

Where G(f) is the Power Spectral Density (PSD) of the signal, H(f) is the receive band-pass filter (BPF) transfer function, and Δf is the carrier spacing between adjacent channels.

3. U.S. Cellular Industry Standard (IS-54) Definition and Specification of Adjacent Channel Interference

The receive band-pass filter is assumed to be a 25 kHz brick wall filter. This definition is consistent with the U.S. digital cellular (IS-54) system with the exception that this standard uses a receive bandwidth of 30 kHz. In this standard the first channel ACI is specified to be -26[1] dB below the desired carrier power in a 30 kHz bandwidth. In a 25 kHz bandwidth the equivalent power would be -25.2 dB below the desired carrier power.

4. Power Spectral Density of the Final Analysis Transmitters

Figure I, labeled "GMSK Normalized PFD" shows the PFD of the FAISAT transmitter normalized to the transmission rate. The modulation parameters are as follows:

a. Gaussian Minimum Shift Keying
b. BT=.5
c. Non Linear Amplifier (Hard Limited Channel)

GMSK modulation has a constant power envelope and as such may be amplified by a non-linear power amplifier with minimal spectral re-growth.

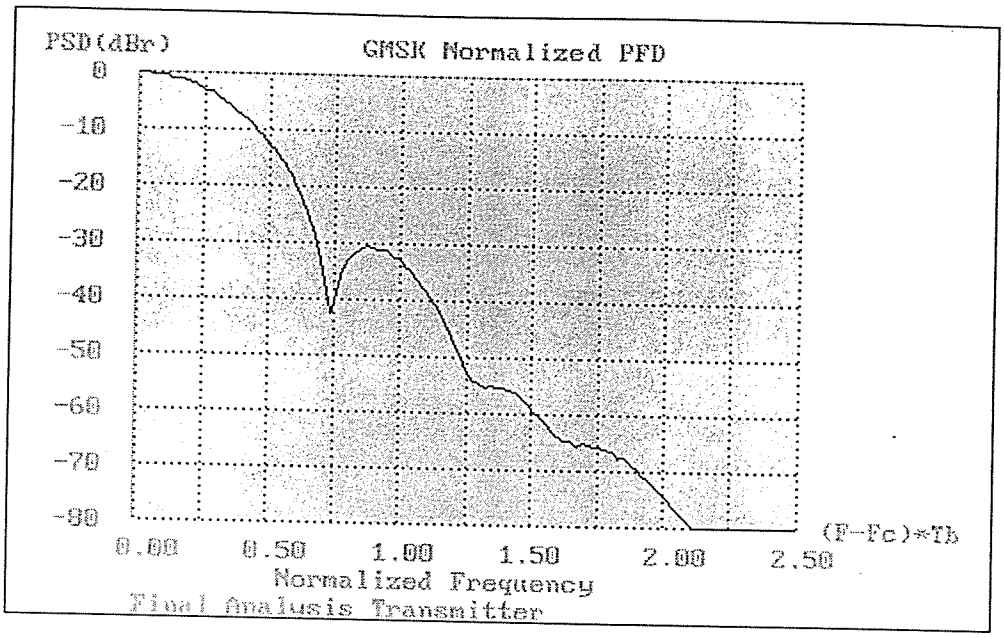
It is important to note that the chart is normalized to zero and shows the roll-off relative to the center PFD as a function of frequency offset from carrier center. The power flux density at the center frequency is reduced from total carrier power and is a function of the type and rate of modulation. For GMSK (BT=.5) the relationship to carrier power and carrier power flux density in a 4 kHz bandwidth at carrier center is as follows:

a. Bit Rate = 96,000 bps, Carrier PFD/4 kHz = Carrier Power -11 dB
b. Bit Rate = 19,200 bps, Carrier PFD/4 kHz = Carrier Power -4 dB

The above results are based on generated direct measurement of a simulated downlink signal by laboratory simulation using a variety of state-of-the-art equipment including an Arbitrary Waveform Generator and a Vector Signal Analyzer.

[1] Feher, Kamilo - "Wireless Digital Communications", 1995, Prentice Hall, Inc.

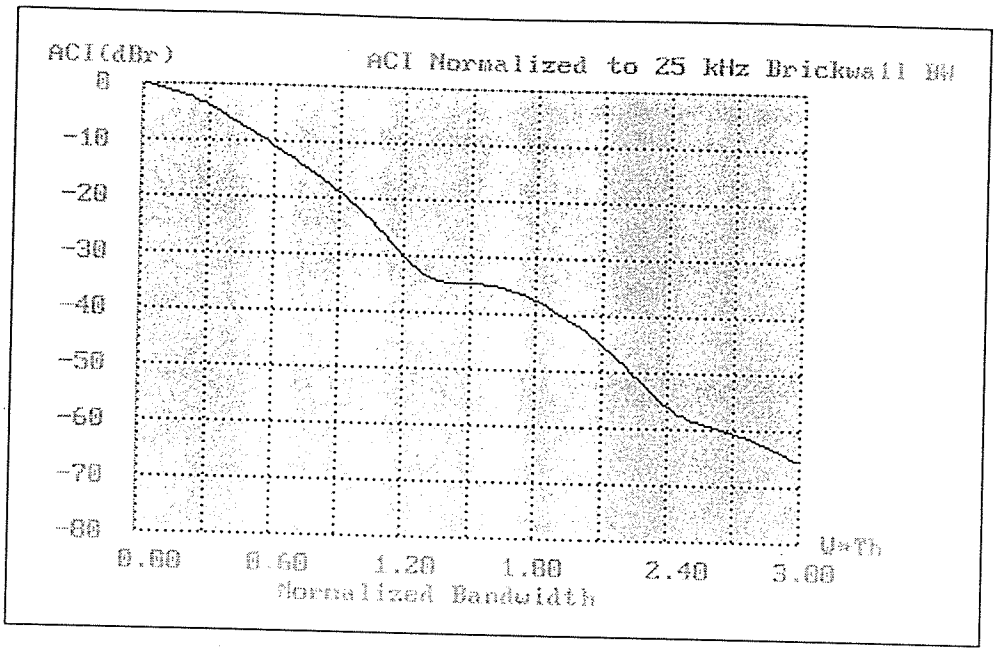
GMSK Normalized Power Flux Density



5. Adjacent Channel Interference from Final Analysis Transmitters

The chart labeled "ACI Normalized to 25 kHz Bandwidths Brick-wall BW shows the Adjacent Channel Interference that would be received by a receiver with a receive bandwidth of 25 kHz and a brick-wall band-pass shape.

ACI in a 25 kHz Bandwidth
Frequency Normalized to Baud Rate



The ACI was calculated for the following specific cases (normalized to PFD at carrier center):

1. Final Analysis transmitter at 137.1 MHz
   Transmitter Doppler shift = -2896 Hz
   Transmitter Frequency Error = -274 Hz
   GMSK Modulation (BT=.5, 96,000 bps)
   Victim Receiver Frequency = 137.0125 MHz
   Victim Receiver bandwidth = 25 kHz (Brick-wall)

2. Final Analysis transmitter at 400.52835 MHz
   Transmitter Doppler shift = -8478 Hz
   Transmitter Frequency Error = -800 Hz
   GMSM Modulation (BT=.5, 19,200 Hz)
   Victim Receiver at 400.4925 MHz
   Victim Receiver bandwidth = 25 kHz (Brick-wall)

For case 1, the PFD roll-off normalized to the PFD at carrier center is -35 dB.

For case 2, the PFD roll-off normalized to the PFD at carrier center is -36 dB.

These cases can be considered to be representative of all channels in the two bands of interest.

4. Conclusion

As stated in Section 3 of this report the U.S. cellular industry finds acceptable out of band emissions less than 25.2 dB below the carrier power in a 25 kHz channel. As indicated in Fig. II, the Final Analysis system out of band emission in the 137 and 400 band are 35 dB and 36 dB respectively below carrier power, a value well within the coordination capabilities of the parties.

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing "**REPLY COMMENTS**" of Final Analysis Communication Services, Inc. was sent by hand delivery or mailed, via first-class mail, postage prepaid, this 15th day of December, 1997, to each of the following:

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