Exhibit I

NARRATIVE DESCRIPTION OF EXPERIMENTAL PROGRAM

I. INTRODUCTION

This exhibit describes the program of research and experimentation proposed by CTA Commercial Systems, Inc. (CTA) in connection with the development and manufacture of subscriber ground terminals for communicating with low-Earth-orbiting (LEO) satellites. The user terminals are being developed initially for use in connection with the VITA satellite system. CTA is the prime contractor for ground terminal equipment to be used with the VITA system. To facilitate equipment development, it is necessary for CTA to begin testing and demonstrating of prototype user terminals under actual field conditions.

This Exhibit provides information about the parameters of the experimental program, the specific objectives of the program and the contributions that the program will make towards the timely implementation of new communications services. In general, the experimental program is intended to test and evaluate prototype user terminals, that are under development by CTA, in actual field conditions prior to the scheduled production run of the ground equipment. The experimental program will determine product performance and suitability in a real world environment. CTA is seeking experimental authority herein to operate 300 user terminals for this purpose.

It is anticipated that the experimental program will use the VITA experimental satellite authorized by File Number 4376-EX-MR-94, that is expected to be launched in June 1995, or the VITA permanent satellite (File No. CSS-91-007(3)) when licensing for that satellite is obtained.

II. OVERVIEW OF THE EXPERIMENTAL PROGRAM

CTA is designing and developing the subscriber terminals for the VITA system, pursuant to an agreement with VITA. CTA is the prime contractor for the ground equipment referred to as Field Stations. To date, CTA has undertaken preliminary equipment design activities and prototype equipment is under development. However, this equipment has not been tested under actual field conditions or in association with an operational satellite. The proposed experimental program will provide important information about the terminals and the satellite system, that will be useful in refining the equipment specifications and in demonstrating the ability to co-exist and/or coordinate with existing users of the relevant frequency bands.

The experimental program will consist of detailed technical evaluations of the system that includes Field Station performance. These evaluations will include:

Link Margin Assessment

Bit Error Rate (BER) Validation

Antenna Pattern Verification

Signal Fading Validation

Protocol Operation in the Presence of Noise

The tests will be conducted at various locations within the United States at potential customer locations. The locations will be selected to obtain data about a variety of interference environments and operational situations. The terminals will be used for both fixed and mobile applications. Customer demonstrations may also be part of the experiment. These trials will help determine to what extent customization may be required for specific customers.

The tests will demonstrate the level of functionality provided by the system. This testing will involve approximately 300 Field Stations distributed over the United States to verify system performance over a broad range of environmental and interference conditions.

There are two primary objectives underlying these tests. First, it is hoped that the tests will provide additional data with respect to inter-service coordination and sharing of the band with existing users. The interference environment in these frequency bands is not well understood. Although generalized ground-based data is known, little public information is available about the nature of the interference due to terrestrial systems as viewed from space.

Second, testing is designed to demonstrate system operation and may indicate approaches to optimizing system performance leading to eventual improvements in customer equipment and service. The major system elements, including the satellite, the user terminals and the access and data transport protocols, are all new and tailored to this application.

III. TECHNICAL DESCRIPTION

The experimental program will utilize prototype user terminals communicating with the VITA satellite that is being launched in June 1995 pursuant to experimental authorization. A detailed description of the space and ground segment characteristics is provided below and in the associated FCC Form 442.

A. Space Segment

The proposed experiment will utilize the VITA satellite that is scheduled for launch in

June 1995 (Station KE2XAH). The satellite will be launched into a 670 km circular orbit at an inclination of 88 degrees. This geometry will result in an orbital period of 98.1 minutes that provides 14.7 orbits per day. At the latitudes of the continental United States, approximately three passes per day will be visible for those Field Stations with minimum elevation angles of 10 degrees.

The VITASAT satellite has two receivers that operate between 149.810 and 149.9 MHz. Both receivers can be switched between 2.4, 9.6 and 19.2 kbps. For operations within the United States, the receivers will select the 2.4 kbps mode. There is a single 8 dBW EIRP transmitter, tunable between 400.505 and 400.595 MHz, which can operate at data rates from 9,600 bps to 38,400 bps.

Communications between the satellite and the experimental earth stations will comply with the conditions set forth in a December 13, 1994 memorandum from Mr. William D. Gamble, Chairman of the Interdepartment Radio Advisory Committee (IRAC), to Mr. William Torak, the FCC's IRAC representative, concerning the VITA satellite.

B. User Terminals

The protype user terminals consist of mobile earth stations using packet radio modems that let users send messages in the form of short data packets. The terminals are designed to communicate with the VITA satellite at either 2400 bps or 9600 bps. However, all user terminals operating in the United States are limited to 2400 bps. In order to be compatible with existing users in the band, the system will use a number of methods including band scanning and narrowband, duty cycle limited transmissions to ensure that potential interference with terrestrial systems is mitigated.

The initial user terminals will use low cost microprocessor based circuits and VHF and UHF circuit technologies to acquire modest amounts of user data, generally less than 512 bytes, that will then be transmitted to the VITASAT when the satellite is within view.

C. Emission Bandwith

The experimental terminals operating in the United States will transmit a 2400 baud FSK modulated signal. As many as two signals may be uplinked simultaneously, one each from two different Field Stations, provided that two unoccupied channels are found by the VITASAT band-scan. The bandwidth required for each uplink signal is summarized in Table 1 below.

Table 1. VHF Uplink Required Signal Bandwidth

Baud Rate	2.40 kbaud
Signal Bandwidth[1]	2.90 kHz
Doppler Spectrum	6.76 kHz
Frequency Error	0.30 kHz
Total Spectrum Required	9.96 kHz
Emission Designator	2K90F1D
Nominal Spectrum Required	10 kHz

[1] The 2.4 k baud peak-to-peak frequency shift is 1.7 KHz.

D. Uplink Carrier Frequencies

The uplink carrier frequencies will be selected within the 149.81-149.9 MHz band such that the entire 10 kHz of signal spectrum is contained within that band. The complete list of possible uplink carrier frequencies is listed in Table 2 below.

Table 2. VHF Uplink Carrier Frequency List

Frequency #	Frequency
1	149.815 MHz
2	149.820 MHz
3	149.825 MHz
4	149.830 MHz
5	149.835 MHz
6	149.840 MHz
7	149.845 MHz
8	149.850 MHz
9	149.855 MHz
10	149.860 MHz
11	149.865 MHz
12	149.870 MHz
13	149.875 MHz
14	149.880 MHz
15	149.885 MHz
16	149.890 MHz
17	149.895 MHz

E. Field Station Characteristics

The Field Station characteristics operating in the 10 kHz bandwidth are noted below in Table 3. The antenna configuration for the Field Stations provide low gain, omni-directional coverage suitable for communications with the VITA satellite over wide variations in azimuth and elevation.

Table 3. Major Field Station Characteristics

TRANSMIT	
Frequency	Within 149.81-149.9 MHz band
Transmit Power	20 Watts (maximum)[1]
Cable Losses	0.5 dB
Maximum Antenna Gain	2.5 dBic[2]
E.I.R.P.	15 dBW ERP = 15 - 2.14 = 12.86 dBW = 20 W
RECEIVE	
Frequency	Within 400.505-400.595 MHz band
Cable Losses	0 dB (with filter/LNA directly on antenna)
Receiver Noise Figure	2.5 dB
System Noise Temperature	514° K (assumes 288°K antenna temperature)
Maximum Antenna Gain	2.5 dBic
Polarization Loss	1.1 dB
Effective Antenna Gain	1.4 dBic
Station G/T	-25.7 dB/k

[1] Actual transmitter power and antenna gain will be specified on an application by application basis. Power and gain tradeoffs will not exceed a nominal maximum EIRP of 15 dBW.

[2] See footnote 1 .

F. Link Power Budget

The 2400 baud uplink uses non-coherent FSK detection and is designed for a 10^{-5} bit-error-rate with a threshold of 18 db Eb/No including implementation margin. An example of the clear-sky margins versus elevation angle is shown in Table 4.

Table 4. Link Power Budget 2400 Baud Mode

(Reference: 90° Elevation Angle, 667 km Altitude)

Frequency (MHz)	149.855 (typ)	
G/S EIRP (dBW)	15 (maximum)	
Path Loss (dB)	132.4	
Polarization Loss (dB)	0.5	
Receiver G/T (dB/k)	-28.1[1]	
Received C/No (dB)	82.6	
Bit Error Rate	10-5	
Required Eb/No (dB)	18 [2]	
Required Eb/No (dB)	48.8	
Clear-Sky Margin (dB)	30.8	
Scintillation Loss (dB)	2	
Multipath Loss (dB)	5	
Urban Noise Loss in C/No (dB)	2.3 [3]	
Remaining Margin (dB)		21.5

[1] Receiver G/T calculated based on 288°K antenna temperature and 90° antenna gains.

[2] Required Eb/No includes excess pre-detection bandwidth and implementation margin.

[3] Urban Noise definition based on 5 dB above 288°K per CCIR Report 258-4.

The link margin for the 10 kHz mode is a function of elevation angle. A tabulation of the clear-sky link margin versus elevation angle is shown in Table 5 below.

Table 5. Clear-Sky Link Margin Versus Elevation Angle For 2400 Baud Uplink

Elevation Angle at Field Station	Field Station Uplink Margin
10	22.4
20	26
30	28.9
60	30.6
90	30.8
Typical impairments to the above link margin include:	
Scintillation Loss	2.0 dB
Polarization Loss	0.5 dB
Multipath Loss	5.0 dB
Environmental Loss	2.3 dB
Total Worst-Case Impairments	9.8 dB

The nominal link margin at 10° Field Station elevation angle including the 9.8 dB of typical impairments is 12.6 dB. In high industrial noise regions, this additional margin will be required to overcome the excess man-made noise floor.

IV. COORDINATION WITH GOVERNMENT USERS

Operation of the ground terminals will protect existing government users of the relevant frequency bands in accordance with the prior coordination between VITA and NTIA as reflected in the December 13, 1994 memorandum from Mr. William D. Gamble, Chairman of the Interdepartment Radio Advisory Committee to Mr. William Torak, the FCC's IRAC representative, and the requirements of US323.[1]

[1] US323 provides with respect to the subject frequency bands that (1) no individual earth station shall transmit, on the same frequency being actively used by fixed and mobile stations and shall transmit no more than 1% of the time during any 15 minute period: (2) any single transmission from any individual mobile earth station shall not exceed 450 milliseconds in duration; (3) consecutive transmissions from a single mobile earth station on the same frequency shall be separated by at least 15 seconds; (4) the mobile stations shall be subject to electromagnetic compatibility analysis and coordination with terrestrial fixed and mobile stations.

Operation of the Field Stations will comply with the operational conditions specific to the terminals which were set forth in Mr. Gamble's memorandum. These are:

a. The terminals will have a maximum uplink emission bandwidth of 5 kHz. The maximum total uplink transmit burst rate for any such terminal will be 2400 bits per second.

b. Within any uplink frame, the percentage of non-polled transmissions will be limited to 10% (e.g., 90% of uplink transmissions from each field terminal will be in response to being polled by the satellite with uplink transmission from that particular terminal inhibited at all other times.)

V. CONCLUSION

This experimental program will facilitate development of user equipment by a United States manufacturer and thereby expedite implementation of innovative and publicly beneficial communications services.

157091-01 / DOCSDC1