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FCC, Experimental Licensing Branch, Suite 230, 2000 M ST., MS 1300E1,
Washington, D.C. 20554

Gentlemen:

Please find enclosed a copy of the progress report on the usage of the Experimental License issued to the GeoPhone Company LLC. This report covers and summarizes the testing that was conducted from August 1996 through September 1997 which covers two reporting periods. A copy of this report is also being submitted to the FCC Satellite Engineering Branch, Room 512, 2000 M St., MS 08000B1, Washington D.C. 20554, Attention : Mr. Karl Kensinger.
Any questions pertaining to the following information should be directed to the undersigned.

Operations Manager
Theodore L. Battle

cc: Steve Sweeney

PROGRESS REPORT SATELLITE TESTING

1.0 Scope

This report contains information on the progress of satellite link testing of two GeoPhone Developmental Earth Stations located at GeoPhone headquarters at 180 Admiral Cochrane Drive in Annapolis MD during the period of August 1996 through April 1997. It also contains information on the testing of the pre- production prototypes.

Since April 1997 the developmental electronic equipment has been replaced by newly developed pre-production prototype equipment while retaining the same antenna structure and feed. Testing was done over the SBS- 6 Satellite Business Systems Satellite located at 74 Degrees West Longitude. These Very Small Aperture Terminals (VSATS) are capable of transmitting a frequency hopped spread spectrum signal in the 14.0 to 14.5 GHz band and receiving in the 11.7 -12.2 GHz band . The developmental equipment operated within a bandwidth of approximately 170 kHz and the pre- production equipment operates within a bandwidth of 1 MHz although a complete 43 MHz transponder was leased for the testing.

Antenna Coordinates: The VSAT antenna coordinates are 38.92 degrees North Latitude and 76.55 degrees West Longitude.

Antenna Pointing: The VSAT antenna will be pointed at an elevation of 45.22 degrees above the horizon plane and at an azimuth angle of 175.84 degrees from the Geographic North.

Test Configuration: The test configurations will allow IF test loops and a complete RF test loop including the satellite to be configured. The testing will be done in a sequence to maximize the use of satellite test time to obtain data.

Maximum output power: The maximum available output power from the outdoor unit for the experimental terminal is 5 watts and the maximum available output power from the outdoor unit for the pre production unit is 2 watts in the 14 to 14.5 GHz band.

Approval: Approval was provided for the operation of these earth stations under a class XD MO Experimental License Issued to GeoPhone Company LLC under the call sign WA2XB1 under file number 5305-EX-PL-96. A copy of the license is attached at the end of this report.

Applicable Documents:

1. Commercial documents including by not limited to commercial standards, specifications and drawing, as well as all applicable FCC documents.
2. Industry Documents were Hughes Uplink Requirements Document.

2.0 Purpose

Tests performed on these terminals will provide the initial technology evaluation in the GeoPhone Corporation's VSAT Network product development effort.

The key technologies to be evaluated during this test program will consist of low-rate vocoders, new signal processing algorithms, a new spread spectrum modem and a unique RF hardware architecture.

The purpose of the test series was to establish that the CAMA Waveform could be used to provide two way duplex voice links over an operational KU band satellite and to determine how robust the connection was both during the call establishment and the conversation phase.

The evaluation of GeoPhone's Proprietary Spread Spectrum Modems using the CAMA waveform and low rate vocoder over a satellite link under varying operational conditions while measuring the subjective quality of the voice transmissions and BER performance is one of the goals of this test series. The link design analysis will also be validated during these tests.

3.0 Satellite Accesses

All Satellite accesses were coordinated through Hughes Communication Network Operations (HCNO) and were completely in compliance with Hughes access procedures and requirements for the SBS-6 satellite. Several transponders were used for the testing with transmission always on the Vertical Polarization and reception on the Horizontal Polarization.

The FCC type approved 1.2 meter Channel Master antennas were pointed and optimized to maximize the receive and transmitted signals and to minimize cross polarization interference.

The following table indicates typical access times and the transponders used during the satellite test program.

SATELLITE ACCESS EVENTS

DATE	Start/End (Hrs)	Sat Txpdr	Equip tested
09/05/96	13:45 - 14:00	17	exp. terminal
09/11/96	11:00 - 11:15	17	exp. terminal
09/24/96	16:45 - 17:00	17	exp. terminal
09/24/96	17:25 - 17:40	17	exp. terminal
10/02/96	18:15 - 18:45	17	exp. terminal
10/02/96	18:25 - 18:55	17	exp. terminal
10/02/96	09:55 - 10:10	17	exp. terminal
10/03/96	11:05 - 11:35	17	exp. terminal
10/10/96	09:00 - 09:15	15	exp. terminal
10/10/96	17:15 - 17:45	15	exp. terminal
10/18/96	16:20 - 16:35	15	exp. terminal
10/21/96	08:15 - 08:30	15	exp. terminal
10/28/96	18:10 - 18:25	15	exp. terminal
10/29/96	08:30 - 08:45	15	exp. terminal
10/29/96	09:00 - 09:15	15	exp. terminal
12/09/96	10:45 - 11:15	15	exp. terminal
12/10/96	09:30 - 09:45	15	exp. terminal
12/11/96	16:45 - 17:00	15	exp. terminal

12/12/97	10:05 - 10:20	15	exp. terminal
2/12/97	15:00 - 16:00	15	exp. terminal
3/08/97	11:00 - 11:15	15	exp. terminal
3/10/97	10:40 - 10:55	15	exp. terminal
3/26/97	20:05 - 20:20	15	pre prod.
4/15/97	15:05 - 15:20	15	pre prod.
4/15/97	15:40 - 15:55	15	pre prod.
4/16/97	12:05 - 12:20	15	exp. /pre prod
5/01/97	09:35 - 09:50	15	exp. /pre prod
5/02/97	13:15 - 13:30	15	pre prod.
5/02/97	16:30 - 16:45	15	pre prod.
5/02/97	09:25 - 09:45	15	pre prod.
5/05/97	12:40 - 13:10	15	pre prod.
5/05/97	17:15 - 17:45	15	pre prod.
5/20/97	07:45 - 08:15	15	pre prod.
5/20/97	19:15 - 19:30	15	pre prod.
5/22/97	10:15 - 10:25	15	pre prod.
5/22/97	12:00 - 12:30	15	pre prod.
5/22/97	16:15 - 16:45	15	pre prod.
5/27/97	09:15 - 09:45	15	pre prod.
5/27/97	18:30 - 19:00	15	pre prod.
5/28/97	15:30 - 16:00	15	pre prod.
5/30/97	14:45 - 15:15	15	pre prod.
6/03/97	17:15 - 17:45	15	pre prod.
6/10/97	13:20 - 13:50	15	pre prod.
6/11/97	08:25 - 08:55	15	pre prod.
6/17/97	15:35 - 16:05	15	pre prod.
6/19/97	10:00 - 10:30	15	pre prod.
7/15/97	09:30 - 09:45	15	pre prod.
7/15/97	10:15 - 10:45	15	pre prod.
7/31/97	14:05 - 14:20	15	pre prod.
8/01/97	10:55 - 11:25	15	pre prod.
8/26/97	13:00 - 13:30	15	pre prod.
9/19/97	16:30 - 15:45	15	pre prod.
9/03/97	10:35 - 10:50	15	pre prod.
10/16/97	10:30 -11:00	15	pre prod.

4.0 Test Results

Reviewing the testing program over the twelve months spanned, it can be seen that very effective use was made of satellite access time. The performance of these tests in a laboratory environment, enabled GeoPhone to improve the design of the next generation of its products by incorporating design features that were uncovered during this experimental testing series. During this experimental testing series, testing was done with two different terminal designs.

The two experimental terminals were constructed using available commercial off the shelf hardware and technology. Indoor Unit (IDU) ware comprised of rack mounted equipment in a four foot rack cabinet. The Pre Production Terminals were integrated in a computer tower case using custom software and hardware engineered specifically for this system.

4.1 Test results on the Experimental (Demonstration) units

The testing on the experimental units spanned the time period from August 1996 through March 1997 and were used to verify the design concept and the link performance parameters for the experimental units. This testing enabled the improvement of some hardware and software features in the experimental units and provided performance benchmarks to drive the design of the pre production units. The satellite accesses were used to establish the reliability and robustness of this single channel design. The key technologies evaluated during this experimental terminal program was to evaluate low rate vocoders, new signal processing algorithms, a new spread spectrum modem and a unique hardware architecture. It should be noted the CAMA (Convolution Ambiguity Multiple Access) waveform technique for this test was using MFSK (Multiple Frequency Shift Keying) modulation. The experimental terminals were used to demonstrate CAMA operation over existing commercial satellites.

These units provided one voice channel utilizing a generic SHARC DSP processor, codec, and VSAT hardware. The SHARC DSP processor was programmed to validate the CAMA waveform. The same SHARC DSP processor was used in the Pre Production Terminal to minimize the design changes and risk.

The tests performed during the experimental terminal program were designed to test that the CAMA waveform could be used to provide a two way duplex voice link over an operational KU band satellite and how robust the connection was during the call establishment and the conversation phase. These tests were made over varying operational conditions while measuring the subjective quality of the voice transmissions and BER bit error rate.

We were able to determine how this new CAMA technique would operate in a commercial satellite environment, with its rain fading, proximity of other carriers, Doppler frequency variations, satellite frequency offsets, cross polarization interference effects.

GeoPhone discovered that the frequency acquisition range of the CAMA modem was not broad enough to acquire the return signal from the satellite with the frequency offset and design modifications had to be made to the pre production terminals to compensate for this effect.

The optimal signal levels for operating the various components in the system and the sensitivity of this type of modulation to the non linear effects of saturation of components in the system were determined which helped us to finalize the system design for the pre production terminals.

We also found that we needed a large amount of isolation between the uplinks and the downlink RF equipment to prevent interference, because of the sensitivity of the detection process. This directly affected the design of the pre production terminals in that great care was used in its design to improve the isolation.

We discovered that day/night temperature variations could result in the accumulation of water in the RF waveguide in a humid environment which could damage the equipment. We have made design modifications to minimize this effect.

The lessons learned during the testing of the experimental terminals enabled GeoPhone to make design changes that reduced the equipment cost per channel from $50,000 to $3,000.

During this testing we were able to test and evaluate the following satellite and terminal characteristics and determine solutions for implementing them in the pre production prototypes.

- Compensation of the Doppler shifted frequency of the satellite
- Satellite flux density measurement (SFD)
- Effect of the satellite transponder saturation characteristics on performance
- Compensation of rate of drift and instability of the satellite frequency translation
- Evaluation of power stability of link budget including fading characteristics
- Effect of spatial satellite movement on link performance with a fixed antenna
- Effect of interference signals in satellite environment
- Telephone call setup, connection, and tear down over the satellite.

GeoPhone reviewed the concept of utilizing a network pilot terminal for network frequency and power control and based on test results obtained it was decided to implement a solution by using an innovative software approach. This approach allowed us to have a lower cost terminal. This approach is also consistent with GeoPhone hubless, full-mesh network concept which world allowed for the implementation of a lower cost network sooner.

The following design enhancements were added to the for the pre production units as a result of the experimental terminal testing program and engineering development.

1) Cost reduction.

2) Frequency Aquistion/Tracking.

3) Power control/ Throttling

4) 500 MHz agility

5) Design for C-band and Extended C-band operation

6) Time multiplexed channels

7) Flexible hardware design allowing enhancements to be added via software upgrade.

8) Frequency Hopping for time multiplexed channels.

9) Automatic switching of data, facsimile and voice.

4.2 Test results on the Pre Production Prototypes

Eight pre production KU Band satellite terminals were constructed for test and evaluation. These units use improved software and hardware designs which allowed the complete indoor unit (IDU) to be constructed in a computer tower case and was designed to accommodate four time multiplexed voice, data or facsimile channels simultaneously. The outdoor equipment (ODU) was specifically designed with characteristics to provide improved performance and operational features. From March 1997 until the present, testing was done over 1.2 Meter Ku band antennas over the SBS6 Satellite using these pre production units.

We have simulated the loading and the capacity of network using Matlab software. However, we are planning to test congestion scenarios over the satellite once our 8 terminal network is established.

4.3 Significant test events

12/09/96 Testing of new crystal filters for shared subband operation.
04/16/97 First sucessful telephone call using new modems and existing ODU
05/02/97 First successful 10 minute call achieved with all new pre production units
06/11/97 First successful telephone call between two terminals.
06/18/97 Measurement of total delay including satellite link
10/16/97 Testing of four voice channels between two terminals (non time multiplexed)

5.0 Future Testing Plans

GeoPhone is in the process of installing a eight terminal network by November 1997 that will enable us to fully test the effects of network performance characteristics such as channel loading tests, capacity tests as well as network power and frequency control algorithms. The antennas used for this series of testing will be the FCC and Intelsat approved Prodelin 1.8 Meter Ku Band antennas as well as the existing 1.2 Meter Channel Master antennas. The 1.8 Meter Antennas will be located in Annapolis,at 905 Commerce Drive, well within the 161 km FCC limit.

The risk of operating a network at customer sites which will be located in developing countries will be greatly reduced as a result of GeoPhone having tested and evaluated an operational eight terminal satellite network in Annapolis.

Once we have completed this series of testing, we will be able to start to ship networks to our customers in developing countries for implementation.