WA2XCT

SANDERS
A Lockheed Martin Company
P.O. Box 868
Nashua, NH 03061-0868

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Federal Communications Commission
Experimental Licensing Branch
Suite 230 MS 1300E1
2000 M Street
Washington, DC 20554

RE: Sanders (A Lockheed Martin Company)
WA2XCT (File No. 5645-EX-ML-97)
Manchester, NH

Sanders, A Lockheed Martin Company, hereby submits its Second Semiannual Progress Report to the Federal Communications Commission (FCC) on the status of its Personal Communications Service (PCS) experiments at 18W (ERP). This report describes Sanders PCS-Over-Fiber hardware and recent developmental activities.

1. EXECUTIVE SUMMARY

FCC experimental license 5645-EX-ML-97 was awarded on March 5, 1997, to allow Sanders to conduct experiments using their newly-developed PCS-Over-Fiber (PCSOF) Remote RF Head/Hub Interface Converter (RRFH/HIC) system at it's facility on 955 Perimeter Road in Manchester, NH. This report documents progress from September 5, 1997 through March 5, 1998.

The Sanders PCSOF system provides the means to distribute wireless Personal Communication System (PCS) services over existing and dedicated fiber cables. The system utilizes the Code Division Multiple Access (CDMA) spread spectrum protocol for communication.

Progress highlights for the past six months include:

- **Successful simulcast of two PCSOF RRFH/CMI over a dedicated fiber cable.**
- **Successful integration of PCSOF with Hughes Network Systems Qualcomm BTS in Gaithersburg, Maryland.**

2. TEST SUMMARY

A. Sanders' RRFH/HIC System

The following is a description of the Sanders' RRFH/HIC system components:

RRFH: The RRFH is the interface between the HIC and the PCS handsets. It provides the frequency up-conversion from the HIC to the handsets, as well as the frequency down-conversion from the handsets to the HIC. A modular design approach was selected to provide factory and field testability. A RRFH contains four modules: Transceiver, Power Amplifier, Power Supply, and Fiber Optic (FO) Transceiver.

The PCSOF Power Amplifier and FO Transceiver are procured from commercial suppliers. The Transceiver and Power Supply designs were developed by the Telecommunications engineering staff. The Transceiver contains two circuit card assemblies (CCAs), used for upstream and downstream communications. The CCAs are installed in an Electromagnetic Interference (EMI) resisting enclosure to prevent leakage of internally-generated signals and limit susceptibility to interference from sources outside the Transceiver. Specifications were established for several major purchased components in the transceiver, including synthesizers and filters. The Power Supply is a prototype unit designed and built at Sanders. It combines several commercial power supplies into a single assembly to achieve the output voltages needed. The Power Supply provides DC power for each of the modules within the RRFH.

The design of the RRFH was intended to serve as a prototype/proof of concept. Requirements were driven by the general needs of intended customers. The RRFH can be installed on communication towers, building rooftops, billboards, telephone poles, high power transmission towers, or other similar structures. The unit interfaces with the HIC through fiber optic cables, and with the PCS handset through a two-element transmit/receive and a single-element receive antenna. All interconnection hardware, cabling, and antennas are provided by the prospective customers. A commercial aluminum housing was selected for the RRFH. The four modules within the RRFH are interconnected via a wiring harness.

FO TRAY: The FO Tray, located within the Hub Control Unit (HCU) and containing the FO Transceiver, is the RF-to-Fiber interface between the HIC and the RRFH. In the forward path, a PCS signal is passed from the Base Transceiver Station (BTS) to the HIC, where it is converted to RF. The signal is then passed to the FO Tray, where it is converted to 1550 nm in the FO Transceiver, and passed on to the RRFH. It is then converted back to RF in the RRFH's FO Transceiver for transmission to the handset. The signal transmitted from the handset follows the same basic path in the opposite (reverse) direction from the RRFH to the HIC, with the fiber link at 1310 nm.

HIC: The HIC used with the PCSOF system is identical to the unit in production for PCSOC. Minor software modifications were incorporated to adapt the unit for operation with the RRFH instead of the PCSOC's CMI.

The HIC processes the signal received through the FO Tray from the RRFH over the fiber cables, and converts it into a format usable by the PCS base station. The HIC also tunes the RRFH to an assigned frequency, translates the upstream (reverse) signal received from the RRFH to the PCS base station frequency, translates the signal received from the PCS base station to the downstream (forward) frequency, and adjusts the power levels required via communication with both the HCU and the PCS base station. Each HIC is designed to provide the communications link with one RRFH in each of its three sectors. Investigation into the feasibility of simulcasting the RRFHs to increase the number of fiber optic units per HIC is in process.

The HIC consists of an aluminum housing with an internal CCA. Specifications were developed for many of the major components, including synthesizers, filters, and power supplies, to facilitate procurement from a commercial supplier. The HIC is installed in the HCU at the headend facility, with connections to/from the PCS base station provided by the customer.

HCU: The HCU is an industrial rack-mounted computer, providing the man-machine interface (MMI) to the RRFH/HIC system. It is installed in a commercial 19-inch rack assembly along with the FO Tray and HICs. The rack also contains a power distribution system, and provides physical connection to the base station via cabling to the HICs. The rack may also contain an optional commercial power supply. The rack holds up to 3 HIC assemblies, providing control of up to 9 RRFHs.

The commercial computer, rack, power supply, and other purchased components were selected as a cost-effective solution for providing headend command and control. The computer is identical to the unit used in the PCSOC system. Minor software modifications were incorporated to adapt the unit for operation with the PCSOF system.

The HCU acts as a maintenance tool by monitoring the activities of the RRFHs and HICs. The HCU has the ability to identify faulty components, notify operators at the BTS where trouble has occurred and allowing them to respond and correct the problem to ensure minimal interrupted service.

B. Test Configuration

Non-broadcasting prototype testing against specifications and definitions were conducted in the Manchester development facility using test equipment. An RRFH was connected to a HIC, and controlled by the HCU. Appropriate signal levels were generated and tested in accordance with documented test parameters. All testing proved to be successful.

C. Test Conduct

A field trial in Pittsburgh, PA, was conducted under a local FCC license. A dedicated fiber cable was run between the Sanders-owned Qualcomm® RTS (Roving Test Set), which contains the HCU, and the RRFH on a tower 100 feet high. The test network also included four PCS-Over-Cable Cable Microcell Integrators (CMIs) connected to the RTS, providing coverage in areas of marginal tower reception. The goal of simulcasting PCS-Over-Cable CMIs and PCS-Over-Fiber RRFHs was accomplished with successful results.

With the Qualcomm® RTS (Roving Test Set) back at the Manchester facility, simulcast over PCSOF was accomplished under the experimental license using one RRFH within the RTS over a single fiber cable to a fiber optic coupler to a second RRFH within the lab environment. An evaluation of the data seen was completed and the results were very promising.

D. Conclusion

The PCS-Over-Fiber tests conducted to date under the experimental license have been an integral part of the development of the RRFH/HIC system.

3. FUTURE PLANS

Analysis of the Pittsburgh test results are still being conducted to refine the RRFH/HIC prototype unit, in preparation for extensive open-loop tests in the local Manchester area. More simulcasting of the RRFH/HIC system will be conducted, analyzing other aspects of the entire system. Analysis and testing of the existing unit will continue throughout 1998 with a possible redesign of the prototype to a production unit.