Block I, Phase I Very Long Baseline Interferometry Implementation

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This article is a status report on the implementation of the Block I, Phase I VLBI System.

I. Introduction

The Block I, Phase I VLBI System has been implemented in the Deep Space Network and is currently undergoing system testing. The Block I, Phase I VLBI System (Ref. 1) can be characterized as the modification of existing equipment and the addition of new software in the 64-m subnet and the addition of new hardware and software in the Network Operations and Control Center (NOCC).

II. DSS Configuration

The DSS configuration for Block I, Phase I is shown in Fig. 1. The system utilizes the standard S-band and X-band Antenna Microwave Subsystem and Block IV Receiver Assembly along with the advanced systems VLBI IF converters. The Deep Space Station (DSS) Radio Science Subsystem has been modified by adding a VLBI converter subassembly and a wideband data interface to the Occultation Data Assembly. New Occultation Data Assembly software for Block I VLBI, along with modified software for the Metric Data Assembly and the Antenna Pointing Assembly have been supplied. No changes have been made to any of the remaining DSS subsystems for VLBI. Except for some mechanical change to the Antenna Mechanical Subsystem and the formal transfer of the Metric Data Assembly software, all subsystem changes required for Block I Phase I VLBI have been transferred to

Operations. The Antenna Mechanical Subsystem changes are expected by 1 September 1980 and the Metric Data Assembly software transfer by 7 July 1980.

III. Ground Communications Facility and Network Operations and Control Center Configuration

The GCF-NOCC configuration for Block I, Phase I VLBI is shown in Fig. 2. The Ground Communication Facility remained relatively unchanged except for adding a Data Records Processor and software in order to create a real-time Intermediate Data Record. This Real-Time IDR was not of itself a Block I VLBI requirement, but was necessary for timely creation of Telemetry IDR's. In order to provide real-time visibility into the DSS Operations for Block I VLBI, a Network Radio Science Real-Time Monitor (NRS RTM) and Software were added to the Network Data Processing Area of the NOCC. The NRS RTM monitors the configuration and status of the Deep Space Stations in real-time during the Block I VLBI data acquisition phases. The monitor data are displayed via the Network Display Subsystem in the Network Operations Control Area. Selected monitor data are also backfed to the participating Deep Space Stations for onsite monitoring.

A Block I VLBI predicts program was added to the Network Support Subsystem in order to generate and transmit to the DSSs the predicted angle and source time for the scheduled Block I VLBI passes.

IV. Correlation and Postcorrelation

Correlation and postcorrelation processing of the data received from the participating DSSs is carried out by a program developed and implemented on a general-purpose computer. The products of this processing are clock offset, UT1, polar motion, and station location parameters.

V. Operations Training

Since Block I VLBI operations are not an everyday occurrence (they are scheduled once a week on each baseline), training for the network was a prime implementation consideration. In order to enhance the proficiency for Block I VLBI operations, training packages for VLBI operation were specifically designed and implemented.

The training packages were implemented in two parts. The first part dealt with an overview of VLBI: the purpose, the data type and the Block I system. The second part dealt with the various subsystems involved and with specific subsystem operations and data flow.

During the March, April, May 1980 time frame (DSS 14 downtime), weekly VLBI training passes were conducted on the DSS 43-DSS 63 baseline. These passes were used specifically to maintain proficiency in the network and to train the network controllers in VLBI operation.

Single baseline passes were scheduled on the DSS 14, DSS 43 baseline and on the DSS 14-DSS 63 baseline during the last three weeks of May and the first week in June to reestablish and verify the proficiency at DSS 14 after its downtime.

VI. System Testing

Commencing the first week in June 1980, dual baseline passes (DSS 14-DSS 63, DSS 14-DSS 43) were scheduled weekly. The goal of these system tests is to demonstrate the ability of the network to reliably conduct the Block I VLBI passes and provide the required data results in a timely manner. The system test will be completed 7 July 1980, at which time the Block I Phase I VLBI System will be transferred to DSN Operations.

VII. Summary

The Block I, Phase I VLBI System will be operational to support Voyager project navigation requirements. The system will provide, on a weekly basis, the information related to station clock synchronization, UT1 and polar motion.

Reference

1. Chaney, W.D., and Ham, N.C., "DSN VLBI System MK 1-80," in *The Deep Space Network Progress Report 42-56*, pp. 26-34, Jet Propulsion Laboratory, Pasadena, Calif., April 15, 1980.
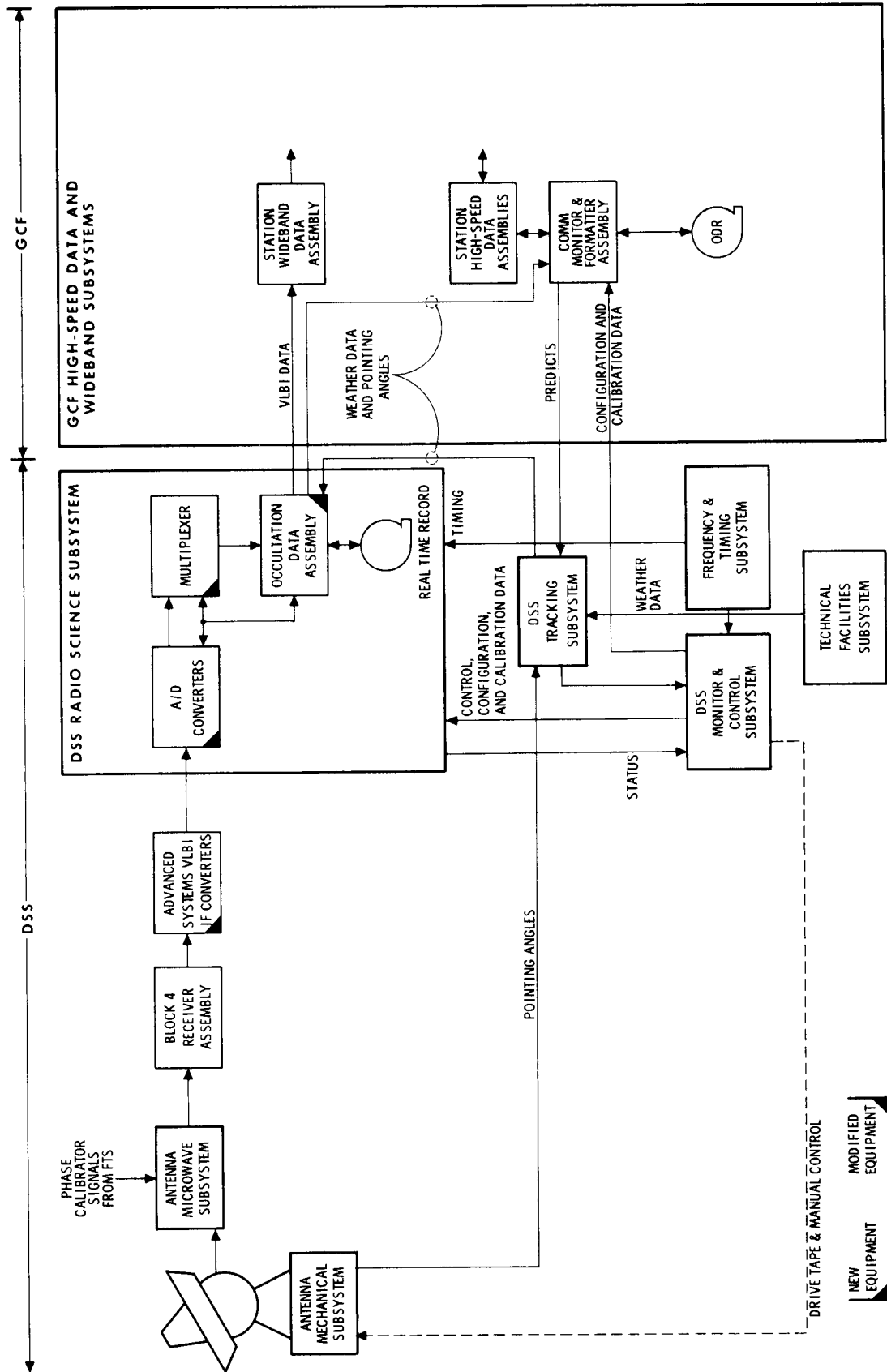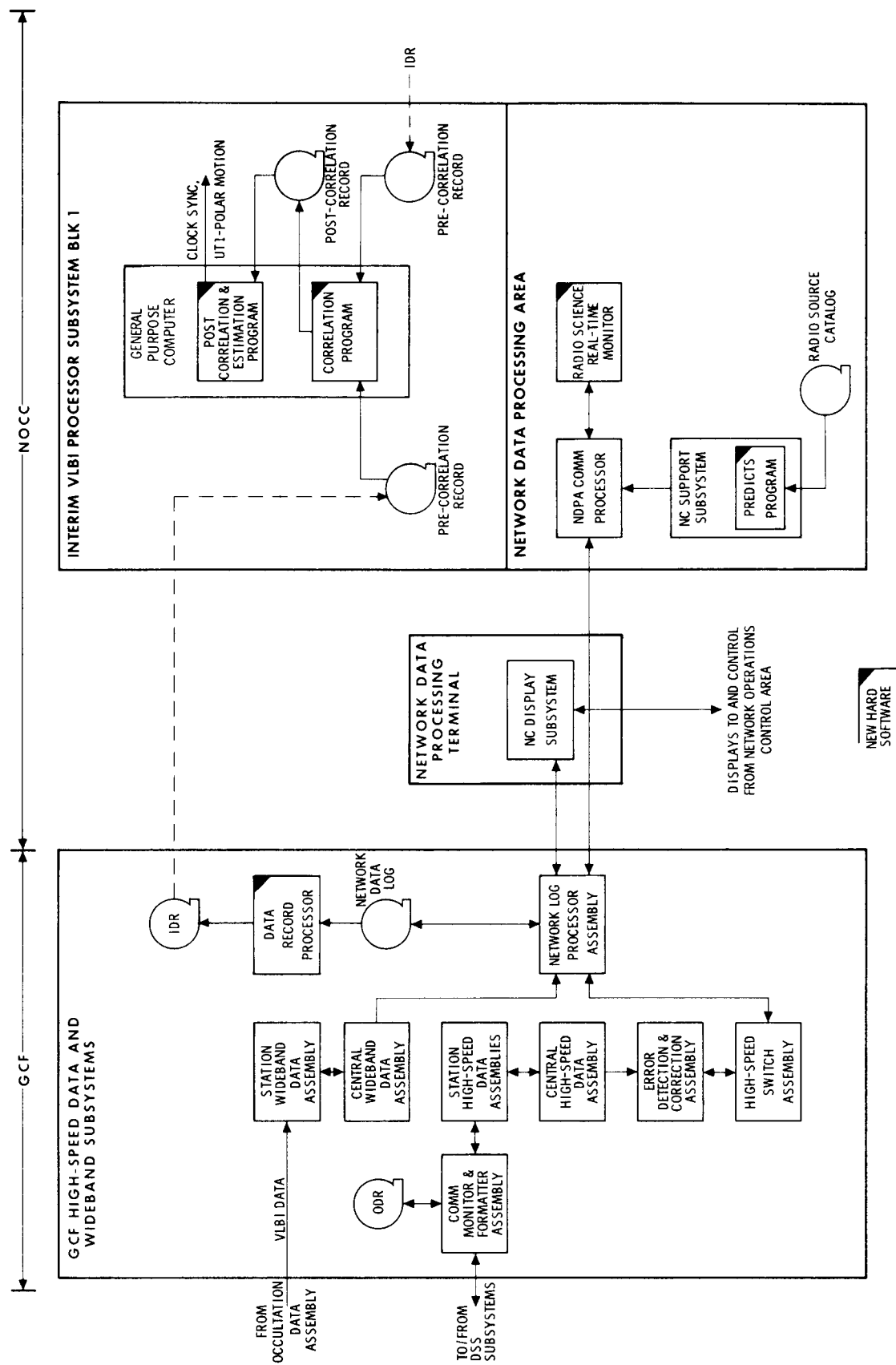
Fig. 1. Deep Space Station block diagram, Block 1, Phase 1

Fig. 2. GCF-NOCC block diagram, Block 1, Phase 1