Digital Recording Acquisition Subsystem for Radio Interferometry Applications Implementation Plan

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This is the first in a series of articles describing the implementation of the Digital Recording Acquisition Subsystem (DRAS) for radio interferometry applications in support of NASA's Crustal Dynamics Project. This article describes the functional and performance characteristics of the equipment and the key aspects of the implementation plan.

I. Introduction

The Digital Recording Acquisition Subsystem (DRAS) being implemented for NASA's Crustal Dynamics Project is the operational version of the so-called Mark III Data Acquisition System. Introduced in 1978, the Mark III System is a digital recording system developed jointly by Goddard Space Flight Center (GSFC), Haystack Observatory, National Radio Astronomy Observatory (NRAO), and Massachusetts Institute of Technology (MIT). The Mark III System is being adapted for the mobile Very Long Baseline Interferometry (VLBI) applications with emphasis on operability, reliability, maintainability and severe environmental considerations. As part of the Crustal Dynamics Project managed by GSFC, the initial application of the DRAS equipment will be for the Astronomical Radio Interferometric Earth Surveying (ARIES), Operational Radio Interferometry Observational Network (ORION), and Deep Space Network (DSN) Block II VLBI projects.

II. Functional Overview

The DRAS is a wideband digital recording system that can accommodate data sample rates from 0.125 to 8 MHz in binary increments. The DRAS equipment configuration is shown in Fig. 1. A functional block diagram of the DRAS is shown in Fig. 2.

III. Important Functional Characteristics

A summary of the important functions and performance characteristics of the equipment is as follows:

A. Important Functions

The DRAS performs the following main functions:

(1) Receives and records VLBI and calibration data supplied by Receiver Subsystem as clipped video signals.

(2) Adds housekeeping information to the basic user data for recording.

(3) Provides real-time and non-real-time recording performance monitor and diagnostic capability.

(4) Reproduces data for post-real-time processing or data reduction.

(5) Provides for remote control of the Subsystem.

(6) Provides a dual-recorder configuration for continuous (overlapped) recording capability and as a warm backup in case of equipment failure in the field.

B. Performance Characteristics

The DRAS has the following performance characteristics:

(1) Instrumentation recorder using 2.5-cm (1-in.) tape on 35.6-cm (14-in.) diameter reels.

(2) Record/reproduce heads with 28 tracks according to Electronic Industries Association (EIA) standards.

(3) Longitudinal density of 13 kbits/cm/track.

(4) Recording code used is non-return to zero mark (NRZM).

(5) Operating modes are normal (recording on all 28 tracks) or shuttle (any number of tracks recorded in successive forward and reverse passes of the tape).

(6) Local or remote control via ASCII teletype current loop or RS232C interface.

(7) Is compatible with the Haystack Mark III data format as shown in Fig. 3.

IV. Key Aspects of Implementation Plan

A. Availability from Commercial Sources

In April 1979, it was jointly agreed between GFSC, Haystack Observatory, and JPL that a commercial source must be found and contracted to replicate the Mark III Data Acquisition System.

JPL agreed to generate documentation packages for competitive procurement bids and identify commercial sources to fabricate complete Mark III systems with JPL acting as the systems contractor for the first unit. For subsequent units, a commercial systems contractor will be sought.

JPL contracted Haystack Observatory to deliver two (2) Mark III Data Acquisition Systems in July 1980 and March 1981, respectively, to ARIES in order to meet its schedule commitments in support of the Crustal Dynamics Project.

B. Operability and Reliability Considerations

The most common reservations generally expressed about recording equipment center around operability, maintainability and reliability. The Mark III System was not designed for the mobile environment (mounted inside an electronics van) as required by ARIES and ORION projects. In an attempt to be responsive to these concerns, the following system design goals apply:

(1) The recorder electronics equipment will be ruggedized to withstand shock and vibration due to roadability and air transportability requirements.

(2) An automated prepass performance verification of the recording equipment will be provided.

(3) Some degree of real-time read-after-write data monitoring capability will be provided.

(4) The Monitor and Control Subsystem will remotely monitor and control the DRAS operation.

(5) Tape change will be the only real-time function that the operator will perform; all other functions such as starting, stopping, and rewinding tape will be automated.

(6) The DRAS mean time between failures will be more than 600 hours.

(7) There will be no mechanical or electrical adjustments associated with the recorders.

(8) Modular design will facilitate troubleshooting and repair.

C. Environmental Considerations

The sites that the mobile stations will visit will be very diverse geographically as well as weatherwise. The following conditions are extremely detrimental to the recorder equipment:

(1) Sand and dust can wear the record/reproduce heads rather critically. The head stacks are very expensive and the quality of data recording will be deteriorated significantly. A system will be designed to provide clean, filtered air in the head area.

(2) Relative humidity (RH) chemically reacts with the binder material in almost all the tapes commercially available to be used on the recorder equipment. The design goal will be to keep the head-tape interface area inside the recorder to approximately 50% RH to prevent tape degradation.

V. Current Status Summary

A brief description of the various activities in progress is as follows:

A. Documentation

(1) A large portion of the documentation of the DRAS equipment has been input into the JPL Document

Control. Haystack Observatory (with drafting support from JPL) is currently working on finalizing the Recorder Electronics documentation.

(2) JPL has already initiated the generation of Technical Requirements Documents (TRDs) and/or specifications for the DRAS equipment.

(3) Test procedures will be generated jointly by Haystack and JPL.

B. Hardware

(1) Various options are under study to determine the most cost-effective approach to ruggedizing the DRAS equipment.

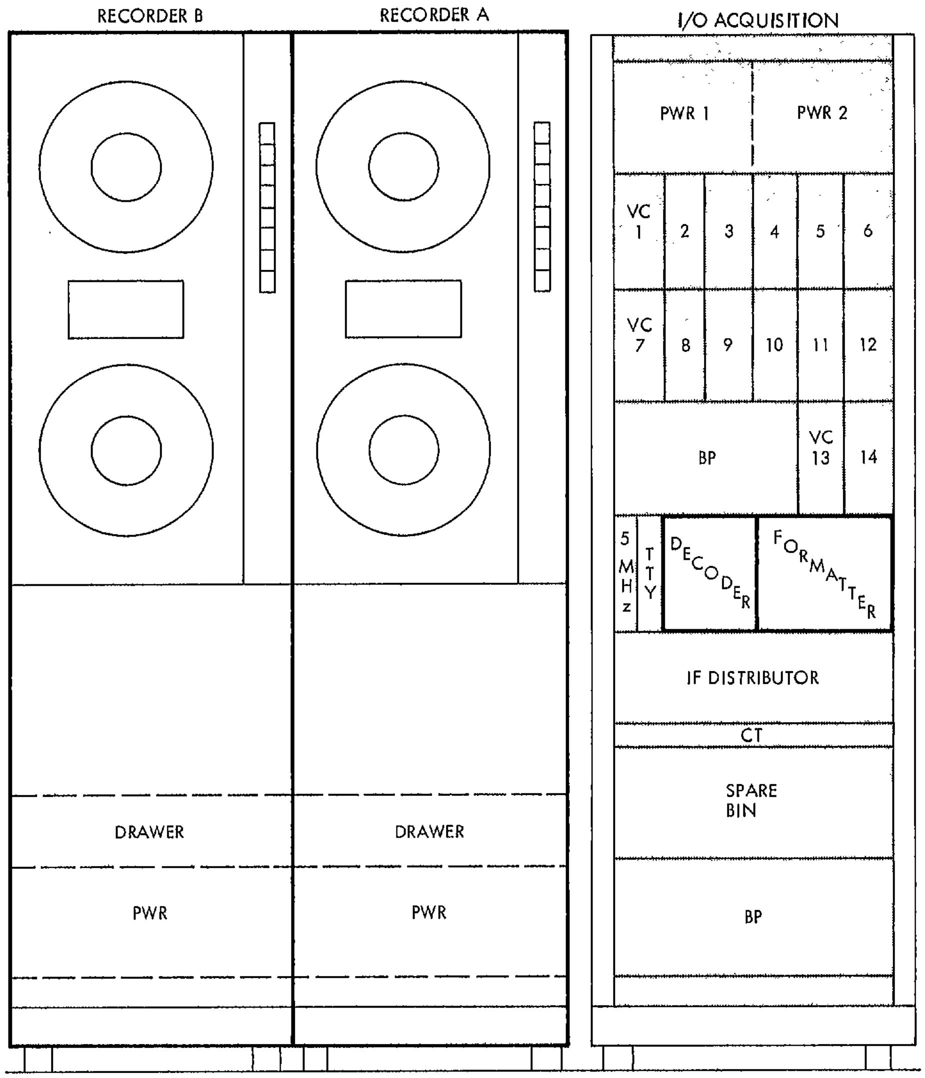
(2) Designs to provide clean and controlled environment in the head-tape interface area are being evaluated.

(3) JPL Quality Assurance (QA) personnel are working closely with Haystack personnel to resolve QA problems on systems to be delivered to the ARIES project.

C. Commercial Sources

A potential list of commercial sources with capability and experience to manufacture, test, deliver and document DRAS equipment is being generated.

Subsequent articles will cover the implementation status in greater detail.



VC= VIDEO CONVERTER
BP = BLANK PANEL
CT= COOLING TRAY

Fig. 1. Equipment configuration, Digital Recording Acquisition Subsystem

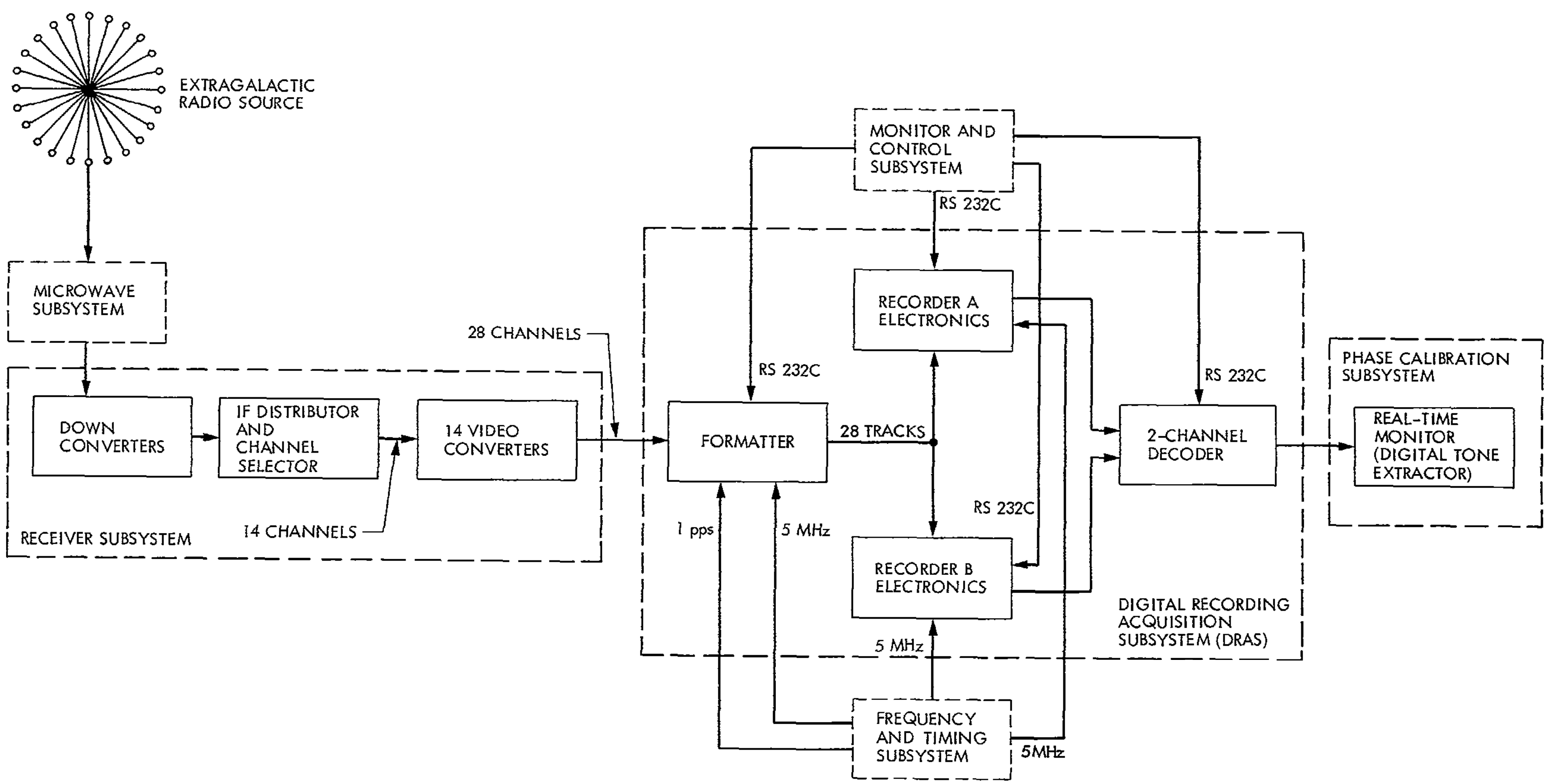


Fig. 2. Functional block diagram, Digital Recording Acquisition Subsystem

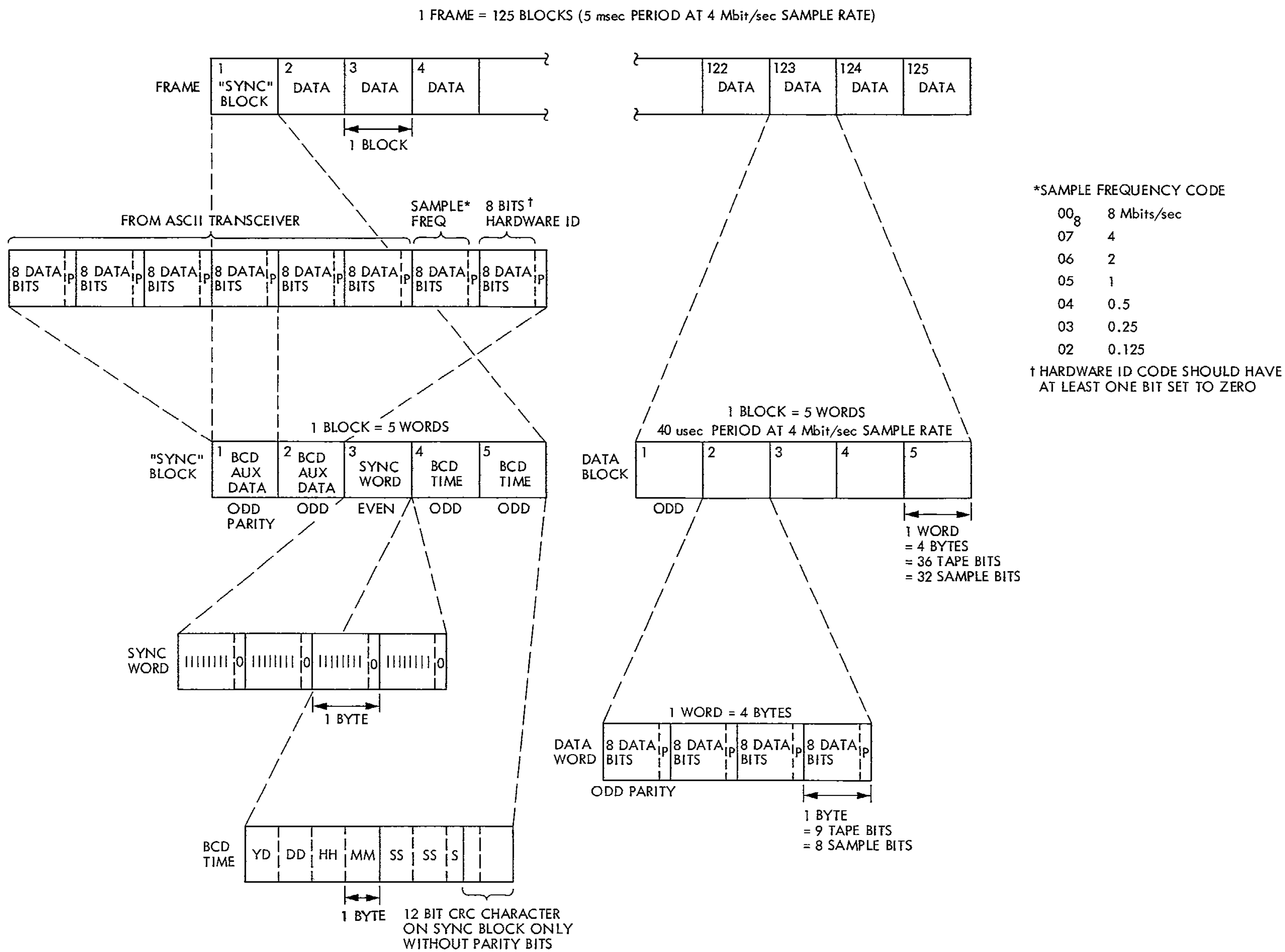


Fig. 3. Mark III data format