DSN Tracking System: Conversion to High-Speed Radio Metric Data

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At the present time, radio metric data are transmitted from the Deep Space Stations via the teletype mode. To meet future requirements, and to update the transmission mode, the operational concept is scheduled to be changed to utilize the high-speed data transmission facilities. This article outlines the implementation schedule and the testing requirements to provide this new capability.

I. Introduction

The transmission of radio metric data from the Deep Space Stations (DSSs) will be changed from the teletype mode to high-speed mode for first use in support of the Mariner Venus/Mercury 1973 Project to meet the requirement of providing 10/s doppler sampling at all stations and dual S/X-band doppler counting at DSS 14. This change involves certain hardware changes, as well as the supporting software packages. The radio metric data will be formatted for high-speed data (HSD) transmission by the station Digital Instrumentation Subsystem (DIS) equipment and transmitted via normal Ground Communications Facility (GCF) HSD circuits.

II. Station Configuration

The present Deep Space Station interface between the Tracking Data Handling (TDH) equipment and the DIS does not provide the required high-rate sampling, the additional doppler count, or the complete status and configuration information. A change to this interface is the first requirement in reconfiguring the stations for the new mode of operation. The necessary Equipment Change Orders (ECOs) have been issued and approved for installation. The implementation of the ECOs will be coordinated with other station changes for the 26-m DSSs and will be included as initial configuration for the new 64-m stations in Australia and Spain (DSS 43 and DSS 63).

III. Configuration Change Schedule

The present schedule for the TDH modification for the station DIS interface calls for the initial implementation at DSS 14. This installation started in the latter part of November 1972 with a tentative completion date of mid-December. Testing will then be conducted at the station to ensure satisfactory operation and make-up of the installation instruction kit. When DSS 14 has demonstrated acceptable operational capability, the instruction kits will
be shipped to the other stations. It is anticipated that the
shipment will be made during mid-January 1973, with
completion of the installation at all stations by the first

IV. High-Speed Data Interface Testing

Interim testing of the software and hardware will com-
mence shortly after the completion of the installation at
DSS 14. The interim testing will be used to allow the pro-
grammers for the DSS and the Mission Control and Com-
puting Center (MCCC) to debug the software packages
being implemented. This testing is scheduled for the
The initial testing will be limited as to decoding the data
block at the MCCC, as the software for this function will
not be integrated into the operational software before
February 1973. Station hardware and software integration,
as well as Deep Space Station testing and acceptance, will
take place between the first of April and mid-June 1973.
This activity will allow limited interface testing of the
capability on a non-interference basis.

V. DSN Combined System Testing

The DSN Combined System Testing for operational
acceptance will be initiated in mid-June 1973 and be com-
pleted, with the capability turned over to operations, by
October 1, 1973. Level 1 and Level 2 testing will be con-
ducted as the stations become available and are accepted.
A Level 1 test will consist of one DSS, configured as for an
actual tracking period, acquiring a spacecraft in one- or
two-way mode, generation of radio metric data, trans-
mitting the radio metric data to the MCCC and Network
Control System (NCS) via GCF high-speed data line, and
the processing of the data by MCCC and NCS, all in real
time. Various sample rates will be used, from 10/s to
1/60 s. Predicts will be generated by the MCCC and trans-
mitted to the station via High-Speed Data Line (HSDL)
and used in the Antenna Pointing System (APS) to drive
the antenna. Simultaneous telemetry and monitor and
operations control data will be transmitted via the HSDL
to present a loading factor comparable to a cruise mode
condition. When conditions allow, the station will operate
in a two-way mode with the spacecraft and command
traffic introduced into the system. All processing capabili-
ties will be exercised, including writing of a project tape
by MCCC to be checked by project programs. Numerous
dumps and displays will be checked to ensure that data
and parameters are correct according to inputs.

A Level 2 test will consist essentially of a Level 1 test
but will be conducted with two or more DSSs simulta-
neously. If a spacecraft is not in view for any of the
stations, simulated radio metric data will be used. The
acceptability of the DSS capability will be based on the
acceptance criteria established for the function.

VI. High-Speed Radio Metric Data

The primary objective of the high-speed data mode of
operation is to provide 10/s, 1/s, and other high-rate
sampling for operations in real time. The current teletype
type for 1/s rate rapidly becomes backlogged and, for
high activity phases of operation, limits real-time evalu-
ation and use of data. The HSD mode will also remove the
last teletype mode from the DSN operational network.
Telemetry, command, and monitor have been operating in
this mode for some time, and with the inclusion of radio
metric data only administrative traffic will continue to be
handled by teletype. The teletype capability will be main-
tained as backup for radio metric data until January 1,
1974.

The data sample rates included in the high-speed data
mode will be 10/s and 1/s and 1 per 2, 5, 6, 10, 20, 30, and
60 s. Twenty samples of data will be included in one HSD
block for the 10/s sample rate and four samples for other
sample rates. The blocks will be transmitted after a HSD
block is complete, according to sample rate, so that the
transmission rate to line will be dependent on the sam-
ping rate. X-band and S-band data will be included for
both range and doppler data. Necessary configuration
information is included to provide complete evaluation
of each HSD block.