DSN Telemetry System: Design for Megabit Telemetry

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A description is presented of the functional design of the additions to the DSN Telemetry System to handle increased data rates up to 30 megasymbols per second. The new system design includes a new demodulator, additional digital recording and formatting, and augmented monitor and control capability.

I. Introduction

The Deep Space Network Telemetry System has been described in Ref. 1. The current configuration, Mark III-77, performs three main functions:

(1) Telemetry data acquisition

(2) Telemetry data conditioning and transmission

(3) Telemetry System validation.

Telemetry data acquisition consists of those functions necessary to extract the telemetry information modulated on the downlink carrier(s) from the spacecraft. Telemetry data conditioning and transmission consist of those functions necessary to decode, format, record, and transmit the data to users. Telemetry system validation consists of those functions necessary to verify the performance of the Network in the acquisition, conditioning, and transmission of telemetry data.

This article describes the system design to handle data at rates up to 30 megasymbols per second. This addition is planned as a multimission capability, initially to support the proposed Venus Orbiter Imaging Radar (VOIR) Mission.

II. Key Characteristics

The key characteristics of the megabit addition to the DSN Telemetry System consist of:

(1) Extension of telemetry data rate capability from a maximum of 250 kilosymbols per second to 30 megasymbols per second.

(2) Maximum-likelihood decoding of short-constraint convolutional codes at the increased symbol rate.

(3) Accommodate data modulated directly on the carrier, i.e., with no subcarrier.

(4) Accommodate either suppressed or residual carrier.

(5) Central station control of all functions via the Monitor and Control Subsystem.

(6) Real-time monitoring of the system performance at the Network Operations Control Center (NOCC).

(7) On-site recording of detected, decoded data for delivery to project user.

(8) Quick-look delivery, in near-real-time, of a limited sample of data.

III. Functional Description

A simplified block diagram of the megabit system is shown in Fig. 1. The megabit stream is handled by the antenna, antenna microwave and receiver in the conventional manner. A new megabit demodulator-detector, now under development, will be interfaced with the receiver to extract and detect the telemetry symbols. A new high-rate decoder is also being developed.

The decoded data are then formatted for interface to a digital recorder. This formatting includes the interlacing with the data of the following status information:

(1) Receiver, demodulator, and decoder lock status

(2) Received signal level

(3) Signal-to-noise ratio (SNR)

(4) Configuration

(5) Data rate

The read-after-write output from the recorder is formatted to allow real-time monitoring of the system performance. The performance monitor is to search for, and verify, the telemetry frame sync pattern in the recorded data. This frame sync status, together with the interlaced status data, are displayed for local operators, and continuously sent to NOCC via GCF high-speed data lines for central network monitoring.

The standard plan for data delivery is to deliver the digital record itself to the project user. A record validation capability will be installed in the GCF Central Communications Terminal to facilitate this delivery. However, additional capability is planned to replay the record at the DSS for transmission to the project via the GCF. Depending on the quantity of data, this playback could occur from 224 kbits per second up to 40 Mbit/s. The GCF is considering a "burst-mode" 40-megabit channel, which could be scheduled periodically to accommodate this replay.

To provide flight projects with a timely sample of the megabit data, a "quick-look" sample is planned for near-real-time delivery. The "quick-look" allows for selecting and buffering up to 30 seconds of data, or about 5×10^8 bits. This buffer can then be replayed over a conventional GCF wideband channel, currently 56 kbit/s.

The megabit capability, as described here, is added in parallel to the current Mark III-77 telemetry capability. The performance will be monitored in the NOCC by the Telemetry Real-Time Monitor (RTM), just as in the current operation. The RTM will be modified to monitor the megabit status indicators, and the quick-look data stream.

Reference

1. Gatz, E. C., "DSN Telemetry System Mark III-77," *The Deep Space Network Progress Report 42-49*, pp 4-7, Jet Propulsion Laboratory, Pasadena California, February 15, 1979.

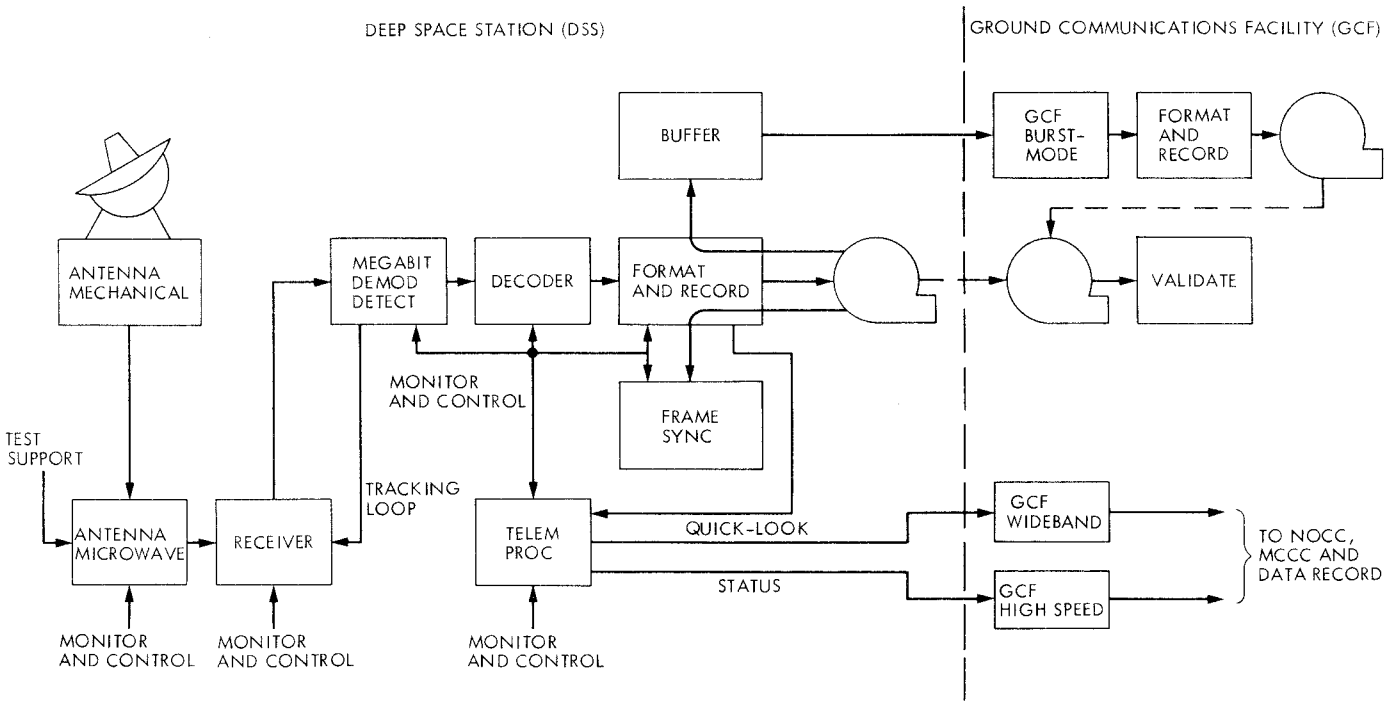

Fig. 1. Megabit telemetry system block diagram