Mariner Mars 1971 Mission Support

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The Mariner Mars 1971 Extended Mission utilizes DSS 14, the 64-meter-diameter antenna station at Goldstone, California, for acquiring telemetry and radio metric data. The 26-meter-diameter antenna stations at Madrid, Spain and Goldstone, California, however, are playing an important part maximizing the quantity and quality of the data received at DSS 14. This article describes the role of the 26-meter-diameter antenna stations presently engaged in the Mariner Mars 1971 Extended Mission.

I. Introduction

Due to the current telecommunications performance margins, only the 64-meter-diameter antenna at DSS 14 can receive meaningful telemetry data from *Mariner* 9.[1] The data rate received can be increased by boresighting the *Mariner* 9 high-gain antenna with the Earth, and by configuring DSS 14 in a "listen-only" mode, i.e., receiving but not transmitting. This mode allows data rates as high as 8.1 kbps to be received from *Mariner* 9, but prevents DSS 14 from commanding the spacecraft. In addition, without a transmitting station, the radio metric data acquired is of little value. The 26-meter stations, DSS 62, DSS 11, and DSS 12, are being employed to perform the transmitting functions for command and radio metric data.

[1]A 26-meter station can receive low-rate telemetry when the high-gain antenna is boresighted with Earth, but the present command support is required prior to the boresighting maneuver.

II. Command Support

While only DSS 14 can acquire the telemetry data from *Mariner* 9, the 26-meter stations are able to provide an uplink to the spacecraft and transmit commands. This capability was used early in the extended mission. On the days that DSS 14 was unavailable, DSS 62 was called upon to transmit commands that helped conserve attitude control gas. These commands were sent "in the blind," i.e., without confirming telemetry data.

Present command support from DSS 62 serves two purposes: (1) allows early transmission of a crucial command in the maneuver sequence, thus providing additional response time in the event of an anomaly; and (2) allows DSS 14 to be in a "listen-only" mode at the start of playback of scientific data from *Mariner 9*.

III. Uplink Support for Improved Metric Data

When a DSS is in a receive-only condition, the resulting doppler data from the spacecraft signal are called one-way doppler. These data do not have the precision necessary for good positional data because of errors introduced by drifts in the spacecraft exciter frequency. Normally the DSS transmits an S-band signal and the spacecraft transponder, by the use of coherent frequency multiplication, converts the signal to a higher frequency which is then transmitted back to Earth. This is a closed, two-way, phased-locked system which provides precision doppler.

Another way of obtaining high accuracy tracking information is to have a DSS in a two-way mode and a second station in a receive-only condition at the same time; the resultant mode of the second station is identified as three-way. Doppler data nearly as precise as two-way can be obtained from the three-way mode.

Metric data of at least three-way precision are required for the *Mariner* Occultation and Celestial Mechanics (CM) Experiments. The Occultation Experiment requires three-way data at entrance of occultation, and the CM Experiment requires three-way data 1 hour prior to and 1 hour after periapsis passage. Using the uplink signal from DSS 62, DSS 14 can receive three-way doppler during "enter occultation." However, the DSS 62 view period ends prior to the periapsis period, so either DSS 12 or DSS 11 (whichever is available) replaces DSS 62 in providing the uplink. DSS 14 can acquire the required metric data while maintaining a receive-only configuration for enhanced telemetry reception.