Viking Mission Support

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In a previous article the basis for integration and data systems testing between the Compatibility Test Area (CTA 21) and the Viking Mission Control and Computing Center (VMCCC) was given, and the first eleven of these tests were described. This article describes the concluding tests in the system integration series and the results of a series of five data system compatibility tests. These tests provide an end-to-end verification of the integrity of the Ground Data System under typical mission loading conditions. Starting with the modulated RF carriers input to CTA 21, the data are sequentially processed through the station, passed across the Ground Communications Facility to VMCCC and finally displayed in the Mission Support Areas. For several of these tests, maximum data loading conditions were established which included six simultaneous telemetry data streams, two command streams, one monitor and one tracking data stream.

This report covers the final tests of the DSN/VMCCC System Integration Test series. It also covers the Data System Compatibility Test Series.

I. DSN/VMCCC System Integration

The interfaces, test plans, and responsibilities for the DSN/VMCCC System Integration Test (SIT) series were described in the last issue. This article gives results of the final test of this series.

A. SIT 12, June 24, 1974 — Two Orbiters and Lander Telemetry and Command

The primary objective of this test was to repeat the steps of SIT 11 and its objectives and to verify specific objectives of earlier SITs which had not been completed or against which liens existed. The secondary objective was to transfer Viking Orbiter and Lander telemetry and command data at maximum rates to determine if constraints existed as applicable to the Data System Compati-

bility Tests and as a result recommend operational workarounds.

The test was to be conducted in four phases.

Phase 1. Transfer and process six telemetry data streams in real-time using the 28.5 kbps wideband line and the high speed data line.

Phase 2. To replay the 7- and 9-track digital original data records (DODRs) recorded during Phase 1 while continuing to process real-time data in one telemetry and command data (TCD) string.

Phase 3. To repeat Phase 1 while using the 50-kbps wideband line.

Phase 4. To repeat Phase 2 for data recorded during Phase 3.

Of the four test phases, only parts of Phases 1 and 2 were completed. Problems included hardware failures at CTA 21, simulation problems, and VMCCC processing problems. For Phase 2, 8-1/3 and 33-1/3 bps engineering data and command data were successfully replayed using telemetry and command processor (TCP) alpha from the 7-track DODR. Time did not permit the use of the DOI-5050-OP-C P-9 module and replay of the 9-track DODR. The test was considered to be only partially successful. The 6-channel simulation conversion assembly (SCA) and Data-Routing Operational Program (DROP)-F software package was used for the first time during this test.

B. GDS-1, 3 July 1974 — Two Orbiters and Lander Telemetry and Command

The primary difference between the SIT tests and the Ground Data System (GDS) test was the use of as much of the GDS as possible for GDS testing, whereas the SIT tests were primarily to test computer interfaces only. GDS 1 was to verify end-to-end telemetry processing of all Viking orbiter and Viking lander data rates. During the short-loop high-speed wideband communications portion of the test, problems with wideband simulation made it obvious that the test objectives could not be completed. The remainder of the test time was used to trouble-shoot these problems. After extensive checkout of wideband communications hardware (GCF and MCCF) it was determined that a problem existed in the MCCC (software) operating system which resulted in only the first 40 bits of each 2400-bit wideband data block being saved for use by other programs. A software correction was made in real-time and data were correctly processed in a short-loop configuration.

C. GDS Retest, July 20, 1974 — Two Orbiters and Lander Telemetry and Command

Objectives for this test were to complete the objectives of GDS-1. Telemetry and Command Systems were successfully tested. Minor problems were experienced in the operation of the 6-channel SCA and DROP-F software; however all were either corrected or suitable workarounds were implemented. With the successful completion of this test, it was determined that the DSN/VMCCC were ready to support the Data System Compatibility testing effort.

II. Data System Compatibility

The primary purpose of these tests was to demonstrate compatibility between the Viking Flight Operations System (FOS) and the Viking spacecraft, Viking Orbiter, and Viking Lander, in response to requirements of the Viking Master Integrated Test Plan. The Data System Compatibility Test Program is divided into three phases as follows:

(1) Design compatibility test (DCT)

(2) Pathfinder compatibility test (PCT)

(3) Flight article compatibility test (FCT)

This report covers the first phase of testing conducted at JPL. Phases 2 and 3 to be conducted with the Spacecraft Compatibility/Monitor Station, STDN, Merritt Island, Florida will be covered in subsequent articles.

The design compatibility phase of testing demonstrated that the basic design of the Viking FOS was compatible with the Viking spacecraft. The tests were divided into six separate phases with results described in *Subsections II A* to *G*.

A. DCT-1, July 15, 1974 — Lander Direct Link Telemetry and Command

The objective of DCT-1 was to demonstrate that GDS design could support the Viking mission and is compatible with Viking lander data transmitted from the Viking lander S-band direct link. It was also to verify the direct S-band command capability. Engineering data at 8-1/3 bps was successfully processed simultaneously with commanding; however, frame lock could not be accomplished on the science data rates of 250, 500, and 1000 bps. After extensive trouble-shooting, it was determined that prerecorded science on the flight tape recorder was in error. It was decided to terminate the test and utilize the contingency test period.

B. DCT-1 Retest, July 17, 1974 — Lander Direct Link Telemetry and Command

This test repeated the objectives of DCT-1. The objectives were successfully met. All Viking Lander data rates (8-1/3, 250, 500, 1000 bps) were successfully processed while simultaneously processing commands.

C. DCT-2, July 21, 1974 — Orbiter Telemetry and Command

DCT-2 was to demonstrate that the GDS, which was designed to support the Viking '75 mission, was compatible with the Viking Orbiter telemetry and command data systems. All objectives were met during this test. Telemetry data rates (8-1/3, 33-1/3, 1k, 2k, 4k, 8k, 16k bps) were successfully processed with simultaneously processing orbiter commands.

D. DCT-3, Uplink, July 22, 1974 — Viking Spacecraft Telemetry and Command

This test was to demonstrate that the GDS design was compatible with the Viking spacecraft (mated Viking Orbiter and Viking Lander hardware) telemetry and command data systems. The test was divided into two parts with the first part to demonstrate uplink design and part two to demonstrate downlink design compatibility. Part one was successfully completed. Commands were transmitted to the mated spacecrafts with verification and evaluation via the downlink telemetry stream.

E. DCT-3, Downlink, Aug. 8 — Viking Spacecraft Telemetry and Command

This second part of DCT-3 was to demonstrate GDS design compatibility with respect to processing Viking telemetry in the Viking spacecraft (mated) configuration. Telemetry data at mated configuration data rates (8-1/3, 33-1/3, 1K and 2k bps) were processed. Commanding was conducted simultaneously with telemetry processing.

F. DCT-4, Aug. 14, 1974 — Viking Lander (Relay) Telemetry and Command

DCT-4 was to demonstrate that the GDS is compatible with telemetry data transmitted by the Viking orbiter which contained both pre-recorded (Track 8) and real-time telemetry data relayed from the Viking Lander. Telemetry data rates (8-1/3, 33-1/3, 1k, 2k, 4k, 8k and 16k bps) for the pre-recorded data were processed. Telemetry at 8-1/3, 33-1/3 and 4k bps (uncoded) was also processed. Orbiter commanding was conducted simultaneously with the telemetry processing. A failure of channel 2 of the TCP at CTA 21 did not compromise the test. The redundant TCP was used following this failure. All objectives were met.

G. DCT-5, July 31/Aug. 1, 1974 — Two Orbiters and Lander Telemetry and Command

The test objective was to demonstrate that the GDS design was compatible with a multi-spacecraft environment. This test was completed in two days. Six simultaneous telemetry streams (8-1/3, 8-1/3, 33-1/3, 16k, 16k, and 1k bps) were successfully processed simultaneously with lander and orbiter commanding. Minor problems existed in simulation of one 8-1/3 bps data stream and the processing of 8-1/3 bps data. Inadequate time was allowed for data transfer tests prior to test start. The test was completed early, which permitted DODR recall of selected low and high data rates recorded during DCT-3. All test objectives were met.

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References

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