DSN Monitor and DSN Operations Control System Testing

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In preparation for Mariner Mars 1971 support, the DSN Monitor System and the DSN Operations Control System were extensively tested singly and thereafter furnished test support to combined system tests, rather than being under test themselves. This practice provided valuable test preparation and execution support.

I. Test Philosophy

A DSN single system test consists of data flow tests and parameter variation tests in all applicable data modes and data configurations; the test control, sequence, and acceptance criteria are designed to test the interfaces, continuity, and performance of only a single system. In a multiple system test, data flow tests and parameter variation tests are conducted simultaneously for all systems.

In preparation for MM'71 support, DSN system tests were run in December 1971 and January and February 1972. The single system testing of the DSN Monitor System and the DSN Operations Control System was exactly as above; however, the testing of these two systems in multiple system tests differed from the above. After thorough single system testing of these two systems, they actually were used as test support for the DSN Tracking, Telemetry, and Command Systems in multiple system tests and in their single system tests. The extent to which Monitor and Operations Control were tested in multiple system tests was only to assure that they suffered no degradation caused by interference from the other systems.

II. Scope of DSN Monitor Single System Tests

Previous articles (Refs. 1 and 2) describe the DSN Monitor System. All DSN system tests are an end-to-end test, including DSIF, GCF, and SFOF data processing. The monitor functions tested were as follows:

(1) Acquisition and display of DSIF and GCF monitor data by the DSN Monitor processor in SFOF.

(2) Consistency between actual conditions, the facility monitor displays, and the DSN monitor displays in SFOF.

(3) SFOF monitor displays.

(4) Consistency between tracking pseudo-residuals computed in the DSIF monitor processor and those computed in the SFOF tracking processor.

(5) The monitor incoming high-speed data (HSD) line de-log (called the M-66 dump). This dump printed HSD blocks on a 1443 line printer in binary, octal, hex, or only the GCF header in readable form.

(6) The DSN monitor processor generation and modification of data sets of DSIF configuration and tolerances intended for generating alarms in SFOF (however, the alarm generation itself was not within the scope of the test run for MM'71 support).

III. Scope of Operations Control System Tests

The testing of this system consisted of generation and transmission of files of data to the DSIF and others. An earlier article (Ref. 3) describes the output router, a part of the DSN operations control system. The operations control functions tested were as follows:

(1) The output router which reads magnetic tape or 360/75 files and encodes the data into HSD blocks for transmission to the DSIF, or encodes into Baudot for transmission via TTY to any destination.

(2) The generation of transmittable DSN sequence of events files using discrete event inputs and trigger event inputs which caused a stored subsequence associated with the trigger to be automatically inserted. These files were transmitted only by HSD line, because line width exceeded TTY capability.

(3) The transmission of files of tracking predicts (generated within the SFOF tracking processor) to the DSIF. Two forms of HSD output are available (in addition to TTY): a character format for page prints and a floating point format for making a mag tape.

(4) The DSIF production of a punched-paper antenna drive tape from the mag tape.

(5) The transmission via HSD and TTY of DSN schedule tapes.

(6) The DSIF reception and printing of the above transmission by the Digital Instrumentation Subsystem (DIS) simultaneously with its monitor processing.

IV. Single-System Test Method and Results

Generally, the tests of both monitor functions and operations control functions were straightforward. Monitor tests followed a procedure which specified configuration and status as a function of time, with voice coordination of display contents. Discrepancies were documented for corrective action and as "calibration coefficients" to be applied in subsequent tests. Operations control functions were tested with all data received by DSIF being mailed back to SFOF for analysis of transmission errors.

V. Multiple System Test Support and Results

Monitor displays were used extensively by personnel concerned with the testing of other DSN systems; information on known display errors was disseminated during pre-test briefings. (It is now apparent that monitor could not repeat single-system test procedures during multiple system tests, as the continual facility configuration changes would interfere with other systems' tests.)

The M-66 dump was used extensively by command to isolate SFOF/DSIF interface problems. Since only inbound data was read, it was necessary to patch outbound lines in the GCF comm terminal to spare inbound lines, to dump data flowing both directions.

All systems used the sequence-of-events generator to produce their test procedures, and again to merge the independent test procedures into a combined system test procedure. The advantage of fast procedure production or modification, coupled with the ability to transmit it to the DSIF is obvious.

The output router was used extensively for the transmission of procedures, predicts, and schedules during tests. Also, tests were run to assure noninterference between its output and SFOF command output.

The only instance of interference to these systems by other systems was that neither the sequence-of-events generator nor the output router could be exercised simultaneously with tracking predicts generation or high-rate telemetry processing without causing the 360/75 to fail from overload.

VI. Conclusions

The philosophy of validating the DSN Monitor System and the DSN Operations Control System during single-system testing and then utilizing them as test support during all subsequent testing paid off by providing valuable test preparation and execution support.

References

1. Maclay, J. E., "Mission-Independent Computer-Driven Volatile Data Displays," in *The Deep Space Network,* Space Program Summary 37-61, Vol. II, pp. 147–150. Jet Propulsion Laboratory, Pasadena, Calif., Jan. 31, 1970.
2. Maclay, J. E., "DSN Monitor System," in *The Deep Space Network Progress Report,* Technical Report 32-1526, Vol. IV, pp. 11–12. Jet Propulsion Laboratory, Pasadena, Calif., Aug. 15, 1971.
3. Maclay, J. E., "DSN Operations Control System," in *The Deep Space Network Progress Report,* Technical Report 32-1526, Vol. II, pp. 4–5. Jet Propulsion Laboratory, Pasadena, Calif., April 15, 1971.