For Network Personnel Only

TECHNICAL INFORMATION BULLETIN

THE MANNED SPACE FLIGHT NETWORK

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TETR-2 IS SUCCESSFUL DESPITE FAULTY BATTERY PACK

Although the test and training (TETR-2) satellite was hampered by a faulty battery pack which severly limited the use of the USB transponder, it served as a dynamic vehicle for test and training prior to each Apollo mission 8 through 13, and provided 697 USB tracking exercises during the test and training phase.

TETR 2 was launched from KSC on November 8, 1968. The event marked the second time an earth-orbiting satellite and a solar orbiting satellite had been successfully deployed from a single launch vehicle (the first involved TETR-1 launched December 13, 1967). TETR-2 obtained an initial orbit of 507 nautical miles apogee and 205 nautical miles perigee. One month after launch, TETR-2 developed a serious performance degradation in the battery pack.

In spite of this critical problem, the MSFN and STADAN accomplished the following:

a. A total of 126 hours and 54 minutes of tracking time was accomulated by 16 MSFN ground stations, 4 Apollo Instrumentation Ships, and 1 ARIA.

b. Station-to-station handovers were satisfactorily performed on 464 occasions.

c. Turnaround exercises of USB PCM telemetry data were successfully performed 277 times.

d. Combined local/remote voice tests were accomplished on 322 occasions.

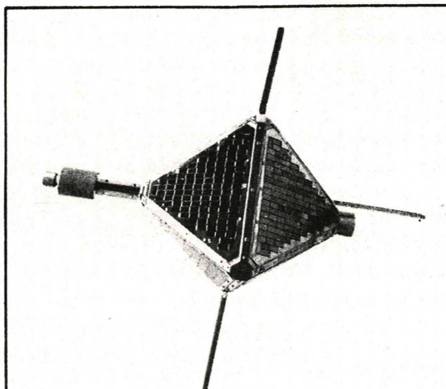
e. One Apollo network simulation and two station simulations, using TETR-2 as a dynamic USB target, were accomplished.

f. Commands were transmitted by STADAN stations 5,015 times.

g. From launch to termination, 543 hours of telemetry housekeeping data were compiled by STADAN stations.

The primary objectives of the second TETR-2 satellite were to ensure that MSFN personnel received realistic training, and to perform engineering and operational tests designed to define

Continued On Next Page



Test and Training Satellite – 2

Reporters Wanted

The Technical Information Bulletin is published for personnel of the Manned Space Flight Network. To be effective it must reflect the interest of the Manned Flight Support Directorate at Goddard Space Flight Center and the personnel at each Network station.

We are asking that all who are a part of the MSFN, especially Station Directors and M&O supervisors, become TIB reporters and relay accounts of important events in your area to us.

Essentially, what we need are articles on MSFN stations, equipment, Network personnel; operating techniques, local modifications, and ideas for improving operation at every level; photographs on station changes and/or improvements; unique situations that have or may affect station operation; interesting developments during the course of a mission, flyover, simulation, or in the performance of day-to-day duties; personal and human interest items if the subject matter relates significantly to project personnel.

All items, a paragraph or several pages, may be addressed to J. Mulvihill, TIB Editor Code 820, Goddard Space Flight Center, Greenbelt, Maryland, or use the MSFN teletype facilities.

MSFN Support Of Apollo 14 Is Excellent

MSFN coverage of the Apollo 14 mission was excellent from the launch phase to lunar landing and to recovery and splashdown. The network systems performance rated high marks with few equipment failures or operator errors affecting mission support.

USB support for the mission was considered excellent. Most of the problems encountered were RF and digital equipment failures, but none of these had any impact on mission support. Most of the problems were resolved in real time.

Except for CRO which experienced a failure of their FPQ-6 4101C radar computer during launch phase, overall C-band support was good. All data requirements were accomplished by the C-band radars that supported; data losses were minor, less than five percent. The last C-band contact with the S-IVB/IU was reported by BDA FPQ-6 radar personnel at a slant range of approximately 86,000 kyds., at 506Z/Feb 2. During this mission, VAN received real-time data from BDA via 2.4 kb/sec data line for antenna positioning. This system worked very well.

Telemetry support was very satisfactory. With the documented contingency procedures and redundant equipment, no station had telemetry system failures which prevented it fulfilling support requirements.

The MSFN UHF command systems performance was good from launch through BDA LOS. No loss of UHF uplink data was experienced during the support period.

All computer support for the mission was considered excellent, with no data losses experienced. With the exception of the CRO 4101 computer, only minor hardware problems were encountered during the mission, and the majority of these occurrences were corrected in a minimal period of time.

The RSDP software support for AS-509 was excellent; there were no engineering data losses due to program errors. Minor problems arose in telemetry and errata were delivered and not implemented.

The ARIA relayed excellent voice, and good data was received by all four aircraft.

The SPAN stations at CRO and CYI provided excellent support throughout the entire mission. No major solar events were observed.

Air-to-ground communications during AS-509 were excellent. The quality of voice and the reliability of equipment

Continued On Next Page

EXCELLENT SUPPORT

Continued From Page One

and personnel performance was very good.

The VAN supported the mission with no major problems.

A preliminary analysis of the MSFN metric tracking data shows that the performance of the tracking network was excellent throughout the Apollo 14 mission.

The analysis and evaluation of MSFN metric tracking data was performed 24 hours per day by Data Evaluation Branch (DEB) personnel during the mission, using the GRTS computer program on the IBM 360/75, the off-line DEB Trajectory Analysis Program (DEBTAP) on the IBM 360/95, and the GRT multiprocessing System (GRTMPS) computer program on the DDP-24.

The GRTS was used extensively by the DEB to examine USB range and Doppler data during 2-way handovers and Doppler data at AOS for gross tracker and data anomalies. The GRTS was also used for orbit determination, lifetime prediction, and for continuous data analysis. DEBTAP was used for refined orbit determination in order to detect more subtle tracking data problems, and to determine 3-way Doppler biases. GRTMPS was used for analyzing HSD noise, logging all incoming tracking data, and providing data summaries.

Each tracking area performed with excellence:

Timing - All sites which satisfactorily participated in the Time Correlation Tests had intro-station timing biases less than 100 microseconds.

Frequency - Premission MSFN PFS offsets were less than 5 parts in 10^{-12}

Doppler - The translunar (TL) and transearth (TE) average Doppler residuals were less than 3 mm/sec (.046 cycles). The RMS Doppler noise during PTC was approximately 6.5 mm/sec (0.1 cycle). Low-speed Doppler data (2-way 1/10 sec) had an RMS noise of 0.3 mm/sec (0.005 cycle) during non-PTC tracking intervals.

Range - Average noise residuals were consistently less than 15 meters with an RMS noise of approximately 7 meters during the TL and TE phases. The larger consistant range (approximately -400 meters) biases observed in lunar orbit are primarily due to the uncertainty in the lunar ephemeris and the lunar force model.

Angles - All USB angle residuals during the TL and TE phase at both the 30-ft and 85-ft prime stations exhibited average O–C's (less than 0.020 degrees) with a corresponding RMS noise less than approximately 0.030 degrees. GDSW, HSKW, and MADW hour angle data residuals were indicative of a deflection coefficient as large as 0.06 degrees.

VAN - The VAN C-band and USB tracking system successfully computed high-speed vectors within required specifications during the launch phase of the mission.

TETR

Continued From Page One

and correct USB systems problems. In spite of serious spacecraft anomalies, 90 percent of all the original TETR-2 mission objectives were completed.

The increased use of TETR-2 for USB tracking accuracy tests prior to each Apollo mission proved very successful, and also provided the Network Director with dynamic verification of MSFN USB systems capabilities. Analysis of USB tracking data, accumulated during normal training exercises, aided in revealing USB systems problems, and follow-up tests verified whether corrective actions were successful.

Requests from the MSFN for spacecraft checkout of station and ship equipment were more numerous than originally anticipated; they comprised a major portion of all TETR-2 activities.

The TETR-2 contained an S-band transponder which was compatible with the USB systems of the MSFN. The S-band transponder provided a means of exercising the USB systems by turning around an uplinked composite signal of PCM telemetry (1.6, 51.2, or 72 kb/sec), voice, angle tracking, ranging, and biomed information. These signals were used singularly or simultaneously.

TETR-2, which was supposed to have acted as a backup to TETR-C, has not been operational since May 5, 1970, but will have a predicted orbital life span of more than 10 years. TETR-C was launched on August 27, 1969, but failed to achieve orbit eight minutes after launch due to a failure in the Delta launch vehicle hydraulic system.

TETR-D, a continuation of the TETR series, is scheduled for launch as a secondary payload with OSO-H in April, 1971.

MSFN test and training satellite 2 scorecard.

Station	Total Tracking Time in hrs./min./sec	Completed Passes	Total MSFN Handovers	PCM Data Turnarounds	Local & Remote Voice Turnarounds
MIL	10:46:05	58	35	12	8
BDA	15:19:05	74	63	16	15
CYI	10:16:00	52	39	13	25
MAD	7:46:05	42	37	5	18
MADX	1:56:05	11	12	-	-
ACN	4:51:00	26	1	25	26
CRO	6:05:00	33	12	18	23
HSK	3:13:05	24	9	20	21
GWM	4:05:05	23	5	19	21
HAW	8:23:05	46	29	18	13
GDS	3:17:00	17	15	6	12
TEX	7:24:00	43	34	11	15
ETC	1:23:05	11	6	10	12
VAN	10:48:00	58	46	13	18
ARIA	00:11:05	1	2	-	-

Note

The MSFN stations which took part in TETR-2 training exercises but were not listed above because of their deletion from the MSFN were: GBM, ANG, GYM, HTV, MER, and RED.

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