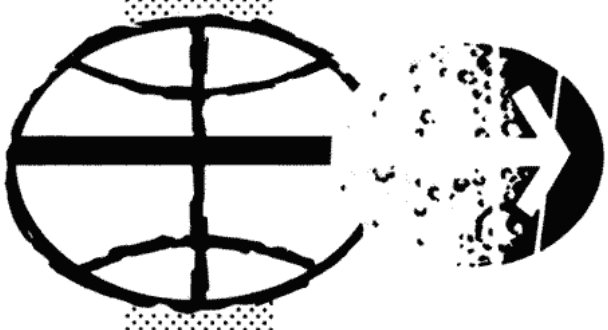
August 15, 1969

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NETWORK CONTROLLER'S MISSION REPORT APOLLO 11



Prepared by

FLIGHT SUPPORT DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

August 2005 Publication Note

The MCC Network Controller's Mission Report for Apollo 11 was a quick look at the performance of the Manned Space Flight Network and the Houston MCC during that historic first landing on the surface of the Moon. It points out problems encountered as well as outstanding areas of support. The original document was provided by Mike Stevens, GSFC Network Operations Manager (NOM) during Apollo 11.

This PDF version was produced by Bill Wood. The original pages were scanned with an Epson Expression 10000XL, using Silverfast AI Studio, to produce high quality 300 pixel per inch, 48-bit images, for further processing. Each page image was straightened and cleaned up in Photoshop CS2 prior to producing 150 pixel-per-inch GIF page images. Microsoft Word 2002 was used to compose the page images into a DOC file prior to conversion to PDF pages. Finally, Adobe Acrobat 7 Professional was used to add the bookmarks before the final PDF edition was produced.

Bill Wood was a Unified S-Band Lead Engineer at the Goldstone Apollo MSFN station during the lunar missions. Mike Stevens was the MSFN Network Operations Manager at GSFC during most of the Apollo missions. Both are now retired in Barstow, California and Riva, Maryland, USA.

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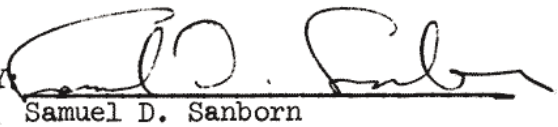
ILLUSTRATIONS

F O R E W O R D

The Apollo 11 Network Controller Mission Report is compiled by personnel of the Operations Section, Code FS45, for the purpose of providing a quick look at the instrumentation support provided by the MCC and MSFN. Because of the lack of time and data available on a quick look basis, this report does not attempt to provide a detailed analysis. This report is intended to be a factual documentory of significant MCC and MSFN events during the Apollo 11 Mission.

APPROVED BY: 

Samuel D. Sanborn
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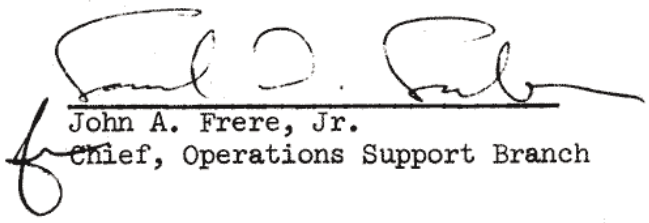

John A. Frere, Jr.
Chief, Operations Support Branch

TABLE I

APOLLO 11 TIMELINE

GMT LO was 16/13:32:00.78

LAUNCH TO TRANSLUNAR INJECTION

EVENT	GET
L.O.	00
SIC/SII Sep	00:02:42
SII IGN	00:02:43
SII C.O.	00:09:08
SIVB IGN	00:09:12
SIVB C.O.	00:11:39
Insertion	00:11:49

TRANSLUNAR INJECTION TO LUNAR ORBIT INSERTION

TLI IGN	02:44:16
TLI C.O.	02:50:03
SIVB/CSM SEP	03:15:01
CSM Dock	03:25
CSM/LM Eject	04:17:13
CSM Evasive Maneuver	04:40:01
First MCC	NA
MCC_2	26:44:38
MCC_3	NA
MCC_4	NA

LUNAR ORBIT INSERTION TO TOUCHDOWN

LOI, IGN (5 min. 59 sec. burn)	75:49:49.6
LOI_2 Circularization (16.4 sec.)	80:11:36.0

CDR IVT to LM	95: 20
LMP IVT to LM	95: 20
Undock	100: 14
CSM Sep (-X Thrusters)	100: 39: 50
DOI (DPS, 70 FPS, 28.5 sec)	101: 36: 14.1
PDI	102: 33: 04.4
Touchdown	102: 45: 40

LUNAR STAY

Stay/No stay for Lunar Surface operations	104: 26
Begin LM crew rest	
CSM Plane change	107: 05
Open Hatch	109: 07: 35
Release MESA, Descent ladder	109: 21
CDR stepped on moons surface	109: 24: 25
LMP begin EVA	109: 43
EASEP Deployment begin	111: 00
EVA Terminate	111: 38: 12
APS IGN (L.O.)	124: 22: 00

LUNAR LIFTOFF TO TRANSEARTH INJECTION

RCS CSI (LM)	125: 19: 34.7
RCS Plane changes (LM)	NA
RCS CDH (LM)	126: 17: 46
RCS TPI	127: 03: 30.8
Docking	128: 03
LM Jettison	130: 10: 00
TEI	135: 23: 42

TRANSEARTH COAST TO SPLASH

MCC_5	150: 29: 54.53
MCC_6	NA
MCC_7	NA
CM/SM Sep	194: 49: 20
Entry Interface	195: 03: 06
Splash	195: 18: 28 (Voice)

1.0 GENERAL

The Mission Control Center (MCC) and the Manned Space Flight Network (MSFN) were placed on mission status for Apollo 11, the first lunar landing mission, on July 7, 1969. Launch occurred on July 16, 1969, at 13:32:0078 GMT. Lunar touchdown was at 20:17:40 GMT on July 20, 1969. Splash occurred on July 24, 1969, at 16:50:28 GMT.

Present information indicates that the ground instrumentation support for Apollo 11 was excellent. Although some system failures occurred, almost continuous support was provided throughout the mission period. The additional task of supporting the Early Apollo Scientific Experiments Package (EASEP) concurrent with the CSM and LM was handled effectively. Operator errors were experienced; however, with the exception of air to ground there was no serious impact to operational support.

Trajectory data was excellent, as was the case in Apollo 10. Local station masking was not the problem it had been during previous lunar missions.

The Parkes, Australia 210 foot antenna did a superb job on its initial MSFN support in providing lunar surface television and EVA voice and data.

1.1 Major System Problems/Considerations

1.1.1 MCC

A. RTCC

The support provided by the RTCC for Apollo 11 was excellent and only one major problem was experienced. On July 18, 1969, at 0340Z the Mission Operations Computer experienced a problem in updating Digital-to-Television displays. The problem resulted in the loss of all real time

television displays for approximately 1 hour and 15 minutes. The problem was eventually isolated to a bad card in the 2701 line adapter, which acts as an interface between the Mission Operations Computer and the display equipment.

B. CCATS CP

CCATS CP support was good throughout the mission; however, a few problems were experienced which caused minor losses of mission data. Throughout the mission the online and standby processors experienced depletion of the RTCC to CP interface buffers. On several occasions this resulted in the loss of data transfers from the RTCC to CCATS and required a CP recycle to clear the problem. Also, a problem was noted during the terminal count when S-IVB data from MIL was decommutated simultaneously with data from ALDS. Under this condition, ALDS data was not processed by the RTCC due to the data validity flag being set to invalid by the CP. Both problems are under investigation and should be corrected prior to Apollo 12.

1.1.2 Manned Space Flight Network

A. Command

(1) HSK and MIL experienced command history aborts during the terminal count. In both cases a second command history request was successfully processed. The cause of these history aborts is still unknown and requires investigation by GSFC.

(2) During the terminal count on July 16, 1969, CRO failed their command interface test due to uplinking an incorrect SLV real time command. An SLV type 2 command history indicated that RTC 106 was uplinked rather than RTC 040. The CRO M&O took a command review which revealed that the data in core for RTC 040 was incorrect. The command computer was reloaded and the interface test was completed successfully. GSFC is requested to investigate this problem and determine what corrective action should be taken.

(3) On July 16, 1969, at 1605Z, the MER experienced a problem with a magnetic tape unit which caused a loss of command history and command computer recovery capability. This problem occurred at approximately 13 minutes prior to MER AOS for TLI. The magnetic tape unit was operational at 1611Z after a defective printed circuit card was replaced. Subsequently, the MER was unable to reestablish an interface between the command computer and the magnetic tape unit by recoverying the computer (CBARF). The MER was then instructed to reload the command computer and the RED was requested to hold the uplink command carrier until LOS. The MER command computer was up shortly after the late handover from RED. The inability to recover the command computer after the magnetic tape unit problem is unresolved. GSFC, in conjunction with the MER, is requested to review this problem to determine the cause and necessary corrective action.

(4) On July 17, 1969, at 1752Z, INCO initiated an RTC execute from MAD while the site was taking a high speed command history. The history was aborted due to the uplink and a high speed history was later requested with no results. MAD attempted to clear the problem by recovering the program with CBARF. The CBARF recovery was unsuccessful and a reload from systems tape was required. The failure of the CBARF was caused by the reassignment of magnetic tape units because of a previous problem; however, the inability to output the command history is still unresolved and requires investigation by GSFC.

(5) On July 17, 1969, at 1759Z ACN experienced six ground rejects while uplinking in Mode 3 without 2-way lock. The reason for the ground rejects is unknown at this time. GSFC is requested to investigate the problem and determine if any changes to present operating procedures are required.

(6) The site status CAP's from 30' USB sites provided a false indication of their command status. Bits 8 and 9 in the status CAP reflected the configuration of the mode select switch but did not indicate whether the command subcarrier oscillator was modulating the carrier. To be useful, the status CAP should reflect accurately the ability of a site to uplink a command. A possible solution is to combine the modulation normal/off switch with the mode select switch to set up-data buffer status bits 29 and 30. These bits would then set bits 8 and 9 in the site status CAP.

B. Telemetry

(1) Although significant effort was expended and errata generated, special function sets were not processed properly by the MILA TMP during the terminal count at 16/0448Z. A playback was attempted unsuccessfully after the computer was faulted and recovered from the fault tape. Subsequently, the computer was reloaded from systems tape and the special function sets were successfully played back to MCC. MILA was then instructed to monitor two computer core locations to determine when these areas changed. These locations were observed to change twice during the terminal count at 1002Z and 1045Z. MILA reloaded from systems tape at 1002Z and performed a fault load at 1045Z. Both procedures normalled the computer core locations. MILA successfully processed special function sets in real time at T minus 1 hour 17 minutes in the terminal count. GSFC is requested to thoroughly investigate this persistent problem and advise MSC of what corrective action will be taken.

(2) During the mission, NST data expressed concern that telemetry playbacks performed during EVA operations could affect processing of PAM data by the telemetry computer. GSFC suspected that the GMT output from the time translator during playbacks could destroy the PAM locations in the computer. This possible problem was not verified during the mission since no playbacks were performed between descent and ascent. GSFC is requested to investigate this suspected problem and advise MSC.

(3) At 0518Z on July 22, 1969, GDS data on both telemetry lines indicated loss of sub-frame sync. GDS reported that each time the time search routine was initiated the computer driven frame counter stopped. This problem is still unresolved and requires investigation by GSFC.

C. Tracking

(1) During launch, uplink lock was lost with the spacecraft between 00:06:00 GET and 00:06:40 GET. The loss of uplink lock appeared to be due to GBM turning off their transmitter 30 seconds prior to the nominal handover time of 00:06:30 GET. GBM reacquired the downlink at 00:06:20 GET and BDA obtained uplink lock at 00:06:40 GET.

(2) The Mercury high speed trajectory data was not available at the MCC during TLI burn support. This was caused by a flexure monitor failure combined with an apparent error in implementing the necessary CDP corrections to circumvent this failure. GSFC should investigate this problem and clarify procedures as required.

(3) The failure of the USB power amplifier at MAD-X was a source of concern several times during the mission. The high temperature at the site was a contributing factor to an apparently marginal condition which exists there. An effort by GSFC engineering is required in identifying and eliminating potential problems in this area prior to Apollo 12.

(4) HSK-X, GBM and BDA also experienced problems with USB power amplifiers. GSFC is requested to review the overall status of USB power amplifiers associated with all MSFN stations. Corrective action, as necessary, should be taken prior to Apollo 12.

(5) The support of the LM during ascent and descent by several sites indicated that high speed doppler support from an uncooled 30 foot site produced excessive errors. The received RF and resultant data signals from the cooled 30 foot and the 85 foot antennas were significantly better than Antigua, the uncooled site. MSC should examine future support requirements and determine if selected uncooled sites should be modified to provide upgraded receiver systems.

(6) The MSFN was unable to maintain 2-way lock from acquisition of the LM at 102:16 GET until the powered descent yaw maneuver was completed at 102:38 GET. Sites were able to maintain solid lock from the completion of this maneuver through LM touchdown. At present, the problem appeared to be due to masking of the LM steerable antenna by RCS Thruster Quad III and/or multipath conditions. MSC will investigate this problem and determine what corrective action can be taken prior to Apollo 12.

(7) All sites experienced a loss of downlink lock during the first 14 seconds of powered ascent. At present, it appears that the LM steerable was able to maintain lock on the uplink during this period. This problem may be due to the ascent engine plume impinging on the descent stage and/or the lunar surface causing a rapid phase change in the downlink signal. This problem will be investigated by MSC.

D. Air-to-Ground

(1) On July 16, 1969, spacecraft downlink voice from GDS was distorted from 1703Z until voice remoting was handed over to MAD at 1732Z. Subsequently, GDS cleared the downlink voice distortion by replacing a cable between the filter data output and the PM voice demod input. However, GDS was unable to later recreate the problem using the suspected cable; consequently, the problem is still unresolved. GSFC is requested to continue investigation of this problem.

(2) On numerous occasions during the mission, excessive noise and distortion of air-to-ground voice was noted on GOSS Conference. In addition, during the MSFN relay configuration the LM crew complained about excessive noise on the uplink. In most cases these problems were due to VOGAA operation. Action should be taken by MSC and GSFC to again examine the use of the VOGAA as a squelch control for the voice downlink and provide an improved capability prior to Apollo 12.

(3) During EVA a noticeable echo of the CAPCOM's voice was evident on GOSS Conference. Subsequently, several sites confirmed that the voice uplink was being received on the downlink from the LM. At present, the problem appears to be associated with the Extra Vehicular Communications System or the LM communications system. MSC will investigate the functioning of these systems. In addition, GSFC is requested to review available data to verify the MSFN configuration during this period.

E. GSFC Communications

Communications support was very good throughout the mission. Several communications outages were experienced but data and communication losses were minimized by effective and timely restorations. The wide band data system between GSFC and MSC experienced numerous problems due to microwave fading, unstable weather conditions, and data modems at MCC; however, major data losses were avoided by the effective use of redundant circuits and terminal equipment. The problems encountered at MCC with data modems indicated a need for a comprehensive checkout of the entire wide band data system, including backup components, prior to future missions.

1.2 Procedures

1.2.1 The need exists to develop a handover plan suitable for use in an FM only downlink mode. The present handover procedure does not provide the uprange station with a method for synchronizing uplink carriers. This procedure should include actions to prevent slewing of the LM steerable antenna during handover. GSFC should pursue this action.

1.2.2 The procedure for sites reporting spacecraft voice calls not acknowledged by MCC was very successful this mission. However, on several occasions unnecessary communication trouble-shooting was performed when the downlink was missed at MCC due to low signal level. GSFC is requested to improve the procedure to include such reports as the quality of the downlink voice, etc.

1.2.3 On several occasions during Apollo 11, MSFN sites were requested to reconfigure from ALSEP support to Apollo support as quickly as possible. Generally, this reconfiguration was accomplished in less than 30 minutes by omitting site readiness testing. MSC realizes that under normal conditions the new site configuration should be validated prior to committing support; however, under certain conditions a rapid reconfiguration is needed to meet mission data requirements. Therefore, GSFC is requested to provide MSC with the times needed by sites to accomplish a nominal reconfiguration and a contingency reconfiguration from ALSEP to Apollo support and vice-versa.

1.2.4 The quality of the television from the 210' antenna at Goldstone during EVA was poorer than the signal from Parkes, Australia. It is MSC's understanding that the system at Goldstone should provide equal, if not better, television quality than the system at Parkes. GSFC is requested to review on-site procedures and equipment configuration to determine if any corrective action is needed prior to Apollo 12.

1.2.5 During Apollo 11, problems were experienced with the CSM high gain antenna locking up on a side lobe. A new procedure was initiated during the mission to correct this problem. When the high gain antenna was observed by INCO to be on a side lobe, the active site was requested by RTC to drop the carrier for 15 seconds, thus causing the high gain antenna to reacquire. This procedure worked effectively. MSC will document this procedure and provide GSFC with inputs prior to the next NOD revision.

1.2.6 Approximately 1 minute of downlink voice was lost after the TLI burn due to the failure of GDS to remote spacecraft voice to MCC. GDS reported that voice was not remoted to MCC due to the sites interpretation of remoting procedures in paragraphs 40.5.4.2 and 40.5.5 of the AS-506 Mission Supplements. GSFC and MSC should review these procedures to determine if additional clarification is needed.

1.2.7 On numerous occasions during the mission, the Houston Comm Tech had to query sites to determine the cause of distortion and noise on GOSS Conference. In many cases, the problem was due to VOGAA operation. This resulted in unnecessary degradation of air-to-ground voice and added unnecessary voice traffic on Net 2. Nominally, sites should have monitored continuously the input and output of the VOGAA's and should have immediately reported any noticeable difference to Network on Net 2 (AS-506 PDC #3). GSFC and MSC should review this procedure, and associated sites procedures, to determine what action is necessary to improve reporting by sites on the operation of VOGAA's. In addition, every effort should be made to implement the required A/G monitoring and control capability at the 85 foot sites.

1.2.8 Some sites showed reluctance during the mission to volunteer pertinent information which could have expedited the resolution of A/G problems by MSC. For example, GDS experienced difficulty receiving and remoting good downlink voice between 1641Z and 1732Z on July 16, 1969. The problem was reported and discussed on Net 2, however, other supporting sites did not volunteer status information to MSC. Finally, at 1722Z the Houston Comm Tech queried MAD which subsequently reported that the downlink voice was loud and clear with no distortion. Downlink voice was subsequently handed over from GDS to MAD and spacecraft voice was improved considerably. GSFC is requested to review the procedure for unsolicited air-to-ground status reporting (Basic NOD 40.2.2.4 A(4)) and take action to improve MSFN support of this procedure.

2.0 CONFIGURATION

The MCC and MSFN configuration at launch was as specified in the following paragraphs.

2.1 MCC Hardware

The configuration of the MCC hardware and equipment was in accordance with AS-506 "G" Mission Data Packs, plus AS-506 MRR's 1 through 86.

2.2 RTCC

2.2.1 Hardware

The RTCC configuration was "D" 360/75 MOC (online) with "B" 360/75 as DSC (off-line).

2.2.2 Software

Mission version program Version 62 with RTOS 10.0.44.

2.3 CCATS

2.3.1 Hardware

The CCATS CP configuration was "A" system online with "B" system as standby.

2.3.2 Software

A. CCATS Version IIIA Generic Program with System Update #16.

B. AS-506 mission specific program with Systems Update #7.

2.4. GSFC CP

2.4.1 Hardware

The "B" system was online with "A" as standby; wide band data line GW 58526 was the prime data path between MCC and GSFC with GW 58527 was the alternate data path.

2.4.2 Software

Systems tape 002 and errata tape 001 plus change requests.

2.5 RSDP

2.5.1 Data core decom programs were as follows:

S1C - LI 001.1
SII - LII 0001.0
SIV - LIV 001.1
IU - LIU 001.0
CSM - LCSM 001.0
LM - LLM 001.0

2.5.2 Data Core/ALDS

2.5.2.1 Hardware

Data Core Module #3 was the online system with Module #4 as backup.

System "B" was the online system with output on both prime (GW 58245) and alternate (GW 58246) wide band circuits. Prime data source was MILA USB for CSM data. System "A" was the standby system with the CIF antenna field selected as the prime USB and VHF data source for LV data.

2.5.2.2 Software

ALDS program 506.1.3 Rev 3 was utilized.

2.5.3 642B

The Remoted Telemetry Program, NCG-725-2 with errata T1 through T7, T9, T11 and Command Program with errata C1 through C10, EMOD-E1, and OUCH 01-017 were used at all remote sites which provided high speed command/telemetry support.

3.0 SYSTEMS PERFORMANCE

3.1 RTCC

3.1.1 The support provided by the RTCC for the Apollo 11 countdown, launch and mission was excellent. The requirement for a Dynamic Standby Computer was reduced for non-critical phases of the mission. Except for the few problems stated below, the overall system provided exceptional support.

3.1.2 Software

During the translunar phase on July 17, 1969, a software problem in the trajectory determining program caused loss of the Mission Operations Computer (75D) at 1140Z. The RTCC was supporting with one computer at the time, consequently, 3 minutes of computer support was lost until a back-up system (75B) was initialized from a restart tape. Approximately 40 minutes of historical data was lost due to initializing from the restart tape. The problem developed while a differential correction was being performed and the low speed data tables were locked. Subsequently, an EOT (End-of-Transmission) was received and trajectory data began to build up in input queues at a rate of one queue per radar observation. In this case, the differential correction processing did not terminate before all available core space was filled. The result was that core lock occurred and computer processing was terminated. Procedural precautions were taken during the remainder of the mission to preclude recurrence of the problem. A modification to the program, which will prevent locking of the low speed data tables, will be available for Apollo 12.

3.1.3 Hardware

On July 18, 1969, at 0340Z, the Mission Operations Computer (75D) experienced problems updating digital-to-television displays. The problem resulted in the loss of all real time digital-to-television displays for approximately 1 hour and 15 minutes. During this period, numerous computer switches and configuration changes were made in an attempt to clear the outage. The problem was subsequently isolated to a bad circuit board in the 2701 line adapter associated with the 75D computer system. The problem was corrected at 0455Z.

3.2 CCATS CP

3.2.1 The following is a summary of CP support anomalies encountered during the Apollo 11 Mission:

A. July 15 (F-1 day)

Time: 15/0430Z

Problem: The Telemetry Instrumentation Controller (TIC) was unable to display telemetry format 9 from MILA on the TIC console.

Impact/Resolution: A delog of the Wide Band Data Interface input revealed that MILA format 9 was being received; however, it was not being processed by CCATS. An in-sync recycle was initiated and the online processor was core dumped. An investigation of the core dump revealed that the decom flag was set for that line from MILA and inhibited display and processing of that line. DR 4261 applies and remains under investigation.

Time: 15/1227Z

Problem: Indicator lights began flashing on all CCATS driven event modules. This problem occurred on three separate occasions, always when the "A" Processor was online (15/1227Z, 15/1654Z, 16/0802Z).

Impact/Resolution: Erroneous indicator lights were momentarily driven when the "A" Processor was online. The problem was isolated to the "A" processor adapter interface by switching the adapters without recycling. A logic card in the scanner selector was replaced, and a bad crimp on a pin in the adapter plug to the scanner was recrimped.

Time: 15/1224Z

Problem: The TIC reported on several occasions that various vehicle status indicators were being driven "OFF" when they should have been driven "ON " (15/1224Z, 15/1525Z, 15/1623Z).

Impact/Resolution: The status indicators were being driven improperly by the CCATS Processor; however, this did not affect the data. This problem occurred only while ALDS Telemetry data was being processed. DR 4263 was written against this discrepancy.

B. July 16, 1969 (F-0 day)

Time: 16/0407Z

Problem: When decom of SIVB Telemetry data was handed over to MILA, all other data being processed from ALDS had the data validity flag in the CP to RTCC header label set to indicate invalid data.

Impact/Resolution: The ALDS input telemetry data was not processed by the RTCC while the validity flag was set to indicate invalid data. The problem occurred on several occasions. DR 4262 applies and remains under investigation.

Time: 16/0530Z

Problem: All CIM inputs to the CCATS Processors were being rejected.

Impact/Resolution: CIM input capability was lost for approximately 12 minutes. Delogs and high speed printers indicated CIM inputs of all zeros. This problem was isolated to a loose adapter plugboard. The plugboard was reseated and the problem did not recur.

Time: 16/0804Z

Problem: CCATS Load Controller (CLC) reported that a CSM Type II History Request was sent to MAD instead of VAN (Time: T-03:56).

Impact/Resolution: The History Request was sent to MAD. It was reinitiated and transmitted to VAN without any problem. Investigation has revealed that at the time CLC site selected VAN on the Command PRM, the CIM/DDD Adapter had dropped its Ready-to-Receive and was unable to pass data. The Adapter was reset shortly thereafter. As a result, the "B" Processor missed the site selection by the CLC and had MAD in its logic

instead of VAN. Immediately prior to CLC executing the History Request, the Network Controller requested that the "B" Processor be selected to online. The "B" Processor was online for about 1 minute, then it was selected to standby at the Network Controller's request. This switching was done during the FIDO trajectory run. As a result the History Request was transmitted while the "B" Processor was online and was sent to MAD instead of VAN.

Time: 16/2002Z

Problem: During a scheduled release of the standby processor for preventative maintenance, the Lead Computer Operator accidentally turned off the online CP to RTCC adapter.

Impact/Resolution: This caused a loss of data to RTCC until the online adapter was turned on and the online processor recycled. Problem was attributed to operator error.

C. July 17, 1969 (F+1 day)

Time: 17/0255Z

Problem: On several occasions, the Tracking Controller reported to the CPC that low speed teletype tracking data was being received from a site(s) and that the console indicator light had not come on. The data was being processed by CCATS and output to the RTCC (17/0255Z, 17/1449Z, 17/1522Z, 19/0782Z).

Impact/Resolution: No data was lost. DR 4264 applies and remains under investigation. In most cases, the problem occurred when the Tracking Controller had these sites drop their data and restart the data with a new start of message.

D. July 20, 1969 (F+4 days)

Time: 20/2330Z

Problem: The online and standby processors experienced loss of RTCC to CP interface buffers (193 word buffers) due to release of a bad buffer base by the Communications portion of the CCATS Program. This problem was encountered on several occasions during mission support, and on four occasions caused an overlay of instructions in the Executive Program (20/2330Z, 21/1730Z, 21/2130Z, 23/0530Z, 24/0230Z).

Impact/Resolution: Depletion of the buffer pool resulted in loss of data transfers from RTCC to CCATS. The 193 word buffer pool was monitored by the CP Controller and the online and standby processors were recycled as required to restore this pool to its maximum, and to restore processing when faulting occurred. DR 4265 applies.

E. July 21 (F+5 day)

Time: 21/1202Z

Problem: RTCC was unable to transfer command loads to CCATS.

Impact/Resolution: No data was transferred from the RTCC to CCATS until the ready-to-receive was reset by the CCATS Processor. Investigation revealed that the CCATS Processor did not have a ready-to-receive up on the CP to RTCC adapter interface. Ready-to-receive was reset manually and a scope was kept on the adapter to monitor the ready-to-receive.

F. July 22 (F+6 day)

Time: 22/0545Z

Problem: The online processor stopped processing low speed teletype data due to an Instruction fault in the Communications portions of the CCATS program.

Impact/Resolution: Low speed teletype data processing was lost momentarily until the standby processor was selected online. DR 4266 applies and remains under investigation.

Time: 22/1227Z

Problem: Online CP unable to process wide band data for approximately 2 minutes.

Impact/Resolution: Approximately 2 minutes of MSFN telemetry data was lost due to operator error. During a scheduled release time of the standby processor, the Computer Operator was instructed to select that Processor's PBT's in the back-to-back mode. Inadvertently, the operator selected the online processor's PBT's to the back-to-back mode. This caused a loss of about 2 minutes of wide band data. The online processor's PBT's were placed in the normal mode of operation, reinitialized and processing was resumed.

G. July 23 (F+7 day)

Time: 23/0001Z

Problem: The online CCATS processor guard mode faulted in the communications portion of the CCATS program.

Impact/Resolution: All processing was lost while the CP was core dumped and recycled. DR 4268 applies and remains under investigation.

3.3 COMMAND

3.3.1 The command support activities for Apollo 11 were very good. There were very few remote site command computer problems experienced during the mission. One computer problem did impact command support during a critical period. Also, a few problems were identified that will require further investigation.

3.3.1.1 MER was unable to recover the command computer with CBARF shortly before their acquisition during the Translunar Injection (TLI) phase. This required holding the carrier at RED until RED LOS. MER reloaded the command computer and was up shortly after the late handover.

3.3.1.2 Several ground rejects and many spacecraft rejects were received during the mission. With the exception of 6 executes to ACN, all ground rejects were the results of executes attempted during "Unable to Command" periods. The spacecraft rejects were the results of executes during periods of marginal signal strength or intentional executes in the blind to attempt to re-establish communications.

3.3.1.3 The problems noted that require further investigation are:

A. The command histories from HSK and MIL aborted during the terminal count interface tests.

B. CRO uplinked an incorrect SLV RTC during the terminal count interface test.

C. During the TLI phase, MER was unable to recover the command program using CBARF.

D. MAD was unable to output a command history following an uplink during the previous history.

E. ACN had 6 unexplained ground rejects while uplinking in Mode 3 without 2-way lock.

3.3.2 The following anomalies were noted during the mission and are listed by GMT day.

A. July 16, 1969 (F-0 day)

Time: 16/0430Z

Problem: Command history from HSK aborted during terminal count interface test.

Impact/Resolution: No impact as another history request was successful and no data was lost. The cause of the history abort is unknown.

Time: 16/0451Z

Problem: Command history from MIL aborted during terminal count interface test.

Impact/Resolution: No impact as another history request was successful and no data was lost. The cause of the history abort is unknown.

Time: 16/0550Z

Problem: CRO command interface test during the terminal count was unsuccessful on the first attempt. The SLV type 2 history showed RTC 106 (Spare) with octal data 757 013 317 156; it should have been RTC 040 (terminate) with octal data 753 553 027 756. The M&O took a command review of RTC 040 and reported the data in core was incorrect.

Impact/Resolution: No impact as a reload of the command computer successfully cleared the problem; the interface test was then successfully completed.

Time: 16/0557Z

Problem: TEX reported a history tape "run away" on a Load Inventory request. This occurred during the terminal count command interface test.

Impact/Resolution: No impact as MCC did receive the Load Inventory and all subsequent actions and results were normal. The cause of the problem is unknown.

Time: 16/0640Z

Problem: The high speed command interface with the VAN was intermittent via SATCOM.

Impact/Resolution: The problem was isolated to a noisy downlink from SATCOM. The command interface with VAN was accomplished by configuring VAN to receive data via 1.2 Kbs HF and to transmit via SATCOM (2.4 Kbs).

Time: 16/0922Z

Problem: Load Control attempted to request a history from VAN; however, the request was transmitted to MAD.

Impact/Resolution: No impact as problem occurred during terminal count interface testing and subsequent executes were normal. Subsequent analysis identified that the problem was due to a CIM input for site select of VAN being missed by the standby CP. While troubleshooting a CP problem, the CP adapters had been switched and this caused the standby CP to miss the CIM input. Further, the history request was initiated within one second after a switch was made to the standby CP; thus, the standby (now the on-line CP) acted on the execute request as if it was requested for MAD, which was the site Load Control had selected prior to VAN.

Time: 16/1215Z

Problem: During Terminal Count, the last uplink retransmission of SLV RTC 040 (terminate) indicated all question marks on SLV command history; also, a ground reject was received for the execute.

Impact/Resolution: There was no impact as the first three uplink transmissions for RTC 040 were nominal and telemetry displays indicated proper SLV response. MIL was transmitting at a very low output power (normal for this period) to the SLV. The resulted in low power to the Verification Receiver (VR).

Time: 16/1605Z

Problem: Mercury reported a "red" Magnetic Tape Unit (MTU), with loss of history and command recovery capability. Problem occurred approximately 13 minutes prior to their AOS for the TLI phase.

Impact/Resolution: There was no impact as the MER MTU was "green" at 1611Z, seven minutes prior to AOS. The problem was corrected by replacing a defective PC card.

Time: 16/1611Z

Problem: MER unable to recover (CBARF) command computer. CBARF had been initiated to re-establish an interface between command computer and the repaired MTU.

Impact/Resolution: The impact was minimized by holding the command carriers at RED until RED's LOS. MER successfully reloaded their command computer and was up shortly after the carrier handover from RED. The cause of the failure to recover was apparently the original MTU failure (see 1605Z entry) or the recovery tape was altered during the troubleshooting.

Time: 16/1855Z

Problem: Eleven CSM executes were missing from the CSM history at MAD.

Impact/Resolution: The impact was loss of command history but no impact on mission. The problem was isolated to a MTU failure; however, the cause is unknown.

Time: 16/2007Z

Problem: Loss of Command Capability at MCC for 2 minutes.

Impact/Resolution: The MCC command capability was lost for approximately two minutes due to an MCC CP problem.

B. July 17, 1969 (T+1 day)

Time: 17/0514Z

Problem: Three executes to HSK were lost; also, two CAP's were not received from HSK on executes that were verbally verified by HSK M&O.

Impact/Resolution: The impact was minor; if there had been any mandatory uplink executes, the HSK M&O could have been directed to perform the uplinking. The problem was isolated to the Wide Band data lines between GSFC and MCC, and further isolated to a Message Unit Radio problem in Jasper, Alabama. Problem was cleared at 0650Z.

Time: 17/1050Z

Problem: BDA command computer "red."

Impact/Resolution: There was no significant impact as BDA was scheduled for only passive support. Problem was cleared by replacing a "stack" in the computer memory. Computer reported "green" at 1113Z July 18, 1969.

Time: 17/1544Z

Problem: MAD CSM Command History was missing several executes and indicated "bad tape record."

Impact/Resolution: The impact was the loss of a Command Histories for several executes. The problem was isolated to a bad MTU; MAD reconfigured the MTU's and cleared the problem.

Time: 17/1752Z

Problem: MAD unable to output a command history.

Impact/Resolution: MAD attempted a CBARF recovery, but was forced to reload when CBARF was unsuccessful. The command carrier was handed over to ACN until MAD completed the reloading. The inability to output the command history was caused by an uplink execute during the previous history printout. The failure of CBARF was caused by the reassignment of the MTU's because of a previous problem.

Time: 17/1758Z and 17/1804Z

Problem: Lost an execute to ACN and an execute to MAD.

Impact/Resolution: No significant impact. Problem was isolated to the Wide Band Data lines between MCC and GSFC. The defective line was turned over to TELCO for troubleshooting and repair. Line was returned to service at 0325Z, July 18, 1969.

Time: 17/1759Z

Problem: Received Ground Rejects for commands uplinked through ACN in a non-MAP Override Mode. Also, ACN's command history showed a ground reject condition on all commands uplinked.

Impact/Resolution: The impact was effectively a loss of command capability until MAD completed reloading their command computer and the carrier was handed back to MAD. Acn was "unable to command" due to a Loss of Signal (LOS) during this period. However, uplink Mode 3 was directed for ACN and ground rejects should not have been experienced.

Time: 17/2031Z

Problem: GSFC attempted to recycle the CP to clear a low speed tracking data problem. The recycle was unsuccessful and a CP reload was necessary.

Impact/Resolution: The impact was the loss of MCC initiated command capability for approximately five minutes. The GSFC CP reload was successful.

C. July 18, 1969 (F+2 days)

Time: 18/1048Z

Problem: MAD telemetry computer faulted and, while the computer was down, CAPs were lost for three executes.

Impact/Resolution: No significant impact as MAD M&O verbally verified response to executes. Telemetry computer was recovered at 1049Z.

Time: 18/1242Z

Problem: MAD-X had a power failure.

Impact/Resolution: The impact was a momentary loss of command capability; the M&O handed over to the prime site. The problem was isolated to the utility power which was providing excitation for the 440 volt alternator which was supplying the PA power. The power was restored at 1245Z.

Time: 18/1351Z

Problem: MAD-X lost power to the USB system 3 power amplifier.

Impact/Resolution: The impact was a 30 second loss of command capability. The Beam Voltage Overcurrent circuit breaker tripped. The Klystron power was reduced and the circuit breaker was successfully reset.

Time: 18/1928Z

Problem: Lost an execute to MAD.

Impact/Resolution: No significant impact as it was successfully re-executed. Execute was not transmitted from MCC as CCATS CMD's High Speed Printer recorded a "Poly" error on the attempted output.

D. July 19, 1969 (F+3 day)

Time: 19/1358Z

Problem: INCO unable to successfully command the spacecraft (S/C); received s/c rejects on all uplinks.

Impact/Resolution: The impact was loss of command capability for approximately four minutes. No ground system problems were identified. Problem was cleared when Astronauts cycled the "up telemetry/ command reset" switch.

Time: 19/2201Z

Problem: ACN reported having computer problems.

Impact/Resolution: No impact as ACN was a passive site. ACN was released to troubleshoot and resolve their computer problems. A defective memory stack was replaced and the computer was reported "green" at 0215Z, July 20, 1969.

Time: 19/2212Z

Problem: GDS reported an Updata Buffer (UDB) failure; ground rejects received on uplink attempts.

Impact/Resolution: The impact was loss of command capability for approximately five minutes; RTC performed a contingency handover to HAW. GDS reported that the problem was due to a defective relay in the UDB; the system was "green" at 2314Z.

E. July 20, 1969 (F+4 days)

No significant problems this day.

F. July 21, 1969 (F+5 days)

Time: 21/0414Z

Problem: GYM command computer faulted.

Impact/Resolution: No impact as GYM was a passive site. The computer was successfully recovered (CBARF).

Time: 21/1158Z

Problem: Unable to transfer loads from MOC to MCC CP.

Impact/Resolution: The impact was an approximate sixteen minute loss of capability to transfer loads from the MOC; if necessary, loads could have been generated and transferred from CCATS CMD's Manual Entry Device. The "Ready to Receive" signal between RTCC and the CP was hung up; it was cleared and normal operation was resumed.

Time: 21/1214Z

Problem: A "CCATS RETRANS" was necessary to successfully transfer loads; however, the light logic indicated output on the first transfer attempt.

Impact/Resolution: No significant impact. GSFC CP delogs showed that the loads were output on the first output transfer attempt; therefore, the load transfers were lost between GSFC and the sites.

G. July 22, 1969 (F+6 day)

Time: 22/0328Z

Problem: An execute (RTC 854, enter) to HSK was lost.

Impact/Resolution: No significant impact as subsequent executes were successful. Execute was lost between MCC and GSFC; probable cause was a momentary Wide Band Data line dropout.

Time: 22/0750Z

Problem: HSK command computer faulted.

Impact/Resolution: No significant impact as CBARF recovery was successful. However, the low speed history was lost and HSK verified historical data by message. The cause is unknown.

Time: 22/1223Z

Problem: Lost four executes to HSK.

Impact/Resolution: The impact was loss of command capability for approximately five minutes. The cause was a PBT configuration error at MCC.

Time: 22/2210Z

Problem: GDS command computer faulted.

Impact/Resolution: No impact as CBARF recovery was successful. Cause is unknown.

H. July 23, 1969 (F+7 day)

Time: 23/2201

Problem: Lost one CAP for an execute due to a GDS telemetry computer fault.

Impact/Resolution: No impact as the M&O verbally verified the command. The telemetry computer was successfully recovered with FLTLD.

I. July 24, 1969 (F+8 days)

Time: 24/0231Z

Problem: Loss of MCC command capability.

Impact/Resolution: Approximately three minutes of MCC command capability was lost due to a CCATS problem.

Time: 24/1235Z

Problem: Lost two executes through GWM.

Impact/Resolution: No significant impact as they were successfully re-executed. GWM reported an interlock dropout on their power amplifier. The interlock was reset and the problem was cleared.

3.3.3 Command Tables

Table II

All uplink executes (excluding load initiates) by site and date. These uplink requests were executed from MCC.

Table III

Total loads uplinked. These uplinks are not included in Table II. Telemetry (TMR) or data rejects (DRJ) for these loads are noted.

Table IV

Total spacecraft rejects (SCR) and ground rejects (GDR). These uplink requests are included in the totals of Table II.

Table V

Total lost executes (LST) and RSCC invalid (RSI) requests. These LST and RSI executes are included in Table II.

Table VI

Total CTE interface executes, SCR's, GDR's, VER's, LST's, or RSI's. These executes are not included in Table II. SCR's are normal indication.

3.3.4 Command Load Operations

3.3.4.1 A total of 239 mission SLV loads were transferred to the network. There were 14 loads per site which were transmitted low speed prior to the terminal count, and loaded by each site during terminal count, after site interface.

3.3.4.2 MILA received one additional load required for launch vehicle pad interface.

3.3.4.3 A total of 199 loads were transferred from T-30 minutes to splash-down. This total included GMTLO to all sites plus one extra GMTLO to MILA at T-30 minutes.

3.3.5 Loads Transferred

A list of loads by site and date as indicated in paragraph 3.3.4.1 is included in the following pages.

JULY 16, 1969

The following were transferred to all sites premission:

4001	4002	4101	4102	4103
4501	4502	4503	4601	4602
4701	5802	5803	5804	

5801 was transferred to MIL

Transferred to MIL at T-30: 6063

The following were transferred Post Liftoff.

ALL	6001				
BDA	0001				
CRO	0003				
CYI	0002				
GDS	0006	1202			
HAW	0006	1202			
MAD	1202				
RED	0003				
VAN	0001	0002			

JULY 17, 1969

ACN	0008	0009	1001		
GDS	1901				
MAD	0008	0009	1001	1901	

JULY 18, 1969

ACN	0011	0012	0701		
MAD	0011	0012	0701		

JULY 19, 1969

ACN	0013	1002	1203		
GDS	0014	0015	1003		
HAW	0015				
MAD	0013	0014	1002	1003	1203

LOADS

JULY 20, 1969

ACN	0016	0017	0018	0606	0901
	1204	2001	2002	2101	2102
	2201	2302	2402	2603	2606
	2802	3904			
GDS	0019	0020	0021	0702	0902
	0902	2102	2103	2104	2606
HAW	0020	0021	0702	0902	0903
	2103	2104			
MAD	0016	0017	0018	0606	0901
	1204	2001	2002	2101	2201
	2302	2402	2603	2802	3904
MIL	0019				

JULY 21, 1969

ACN	0028	0029	0030	0909	0910
	1004	2111	2112	2113	
GDS	0022	0023	0031	0903	0904
	0905	1004	1006	1205	2105
	2106				
GWM	0026	0027	0907	0908	2107
	2108	2109	2110		
HAW	0024	0025	0031	0903	0906
	1004	1006	1205		

LOADS

HSK	0022	0023	0024	0025	0026
	0027	0904	0905	0906	0907
	0908	1205	2105	2106	2107
	2108	2109	2110		
MAD	0028	0029	0030	0909	0910
	0911	1004	2111	2112	2113
MIL	0911				

JULY 22

ACN	0034	1305			
GDS	0032	0033	1304	2003	2114
GWM	1206				
HAW	2003	2114			
HSK	0032	0033	1206	1304	
MAD	0034	1305			

JULY 23

ACN	0035				
GDS	0703				
GWM	0703				
HSK	0703				
MAD	0035				

JULY 24

CRO	0037	1208	1401	0038	
GWM	0037	1208	1401		
HSK	0038				

TABLE II - RTC EXECUTES

DATE	MIL	GBM	ANG	BDA	ACN	CYI	MAD	CRO	HSK	GWM	HAW	GDS	GYM	TEX	VAN	RED	MER	TOTAL
July 16	2			5		2	21	12	1		2	68			14			127
17					7		100		111			75						293
18							237		133			24						394
19							183		150		17	90						440
20							212		49			109						370
21							92		111			64						267
22							131		148			597						876
23							188		148			128						464
24								19	40	110		41				6		216
MISSION TOTALS	2			5	7	2	1164	31	89	110	19	1196			14	6		3447

TABLE III - LOADS UPLINKED

	MIL	GBM	ANG	BDA	ACN	CYI	MAD	CRO	HSK	GWM	HAW	GDS	GYM	TEX	VAN	RED	MER	TOTALS
LOADS UPLINKED	--	--	--	--	--	--	29	1	8	3	---	16	--	--	1	--	--	58
TLM Rej	--	--	--	--	--	--	6	--	2	--	--	4	--	--	--	--	--	12
DATA Rej																		00

TABLE IV - S/C/GND REJECTS

	MIL	GBM	ANG	BDA	ACN	CYI	MAD	CRO	HSK	GWM	HAW	GDS	GYM	TEX	VAN	RED	MER	TOTALS
S/C REJECTS							81	1	52	4	3	11			1			153
GROUND REJECTS					6	---	11	1	6	2	--	20	--	--	2	--	--	48

TABLE V - LOST EXECUTES/RSCC INVALS

	MIL	GBM	ANG	BDA	ACN	CYI	MAD	CRO	HSK	GWM	HAW	GDS	GYM	TEX	VAN	RED	MER	TOTALS
LOST EXECUTES					1		5		9			5			1			21
RSCC INVALS							7		3			14						24

TABLE VI - INTERFACE CHECKS

	MIL	GBM	ANG	BDA	ACN	CYI	MAD	CRO	HSK	GWM	HAW	GDS	GYM	TEX	VAN	RED	MER	TOTALS
EXECUTES	11		10	11	14	10	25	8	27	11	12	11	6	9		1		181
SCR	10		10		13	9	29	8	27	11	12	11	6	8		1		176
GDR						1								1				2
RSI	1						1											2
LST																		
VER					1													1

Remarks:

3.4 Telemetry

3.4.1 Telemetry support by the MSFN and ALDS/Data Core was excellent throughout the mission. The few problems which were encountered were resolved promptly and efficiently; consequently, telemetry data losses were minimal throughout the mission.

There were 48 playbacks of EMOD, real time or DSE dump data during the mission. The line search routines for data retrieval were very effective in minimizing the configuration time required for playbacks. There were no playbacks requested from descent through ascent to avoid overloading the MCC Mission Operation Computer. In addition, GSFC suspected that the GMT output from the time translator could have destroyed the PAM locations in the TMP had playbacks been attempted during EVA operations. This suspected problem was not verified during the mission.

The new decom settings, which set the frame error count to 1 vice 0, were very effective. MSFN sites appeared to be able to maintain decom lock more consistently than during past missions. PAM decom performance during EVA was excellent.

3.4.2 The following anomalies were noted during the mission and are listed by GMT day.

A. July 16, 1969 (F-0)

Time: 16/0345Z

Problem: MIL TMP faulted.

Impact/Resolution: No data was lost since ALDS data was being decommed. An auto recovery from fault tape was performed successfully.

Time: 16/0448Z

Problem: Special function sets were not processed properly by the MIL TMP.

Impact/Resolution: Booster did not see the data real time. After MIL reloaded from the systems tape, the data was processed successfully as a playback. A fault dump was taken for use by GSFC in resolving this problem. After that time, MIL was requested to monitor two locations for special function set processing and reload when activity was seen. MIL successfully processed special function sets in real time later in the terminal count.

Time: 16/0530Z

Problem: The MCC CP stopped outputting ALDS data for other vehicles when SIV/IU was selected from MIL for special function set playback.

Impact/Resolution: A data loss occurred until SIV/IU was handed back to ALDS. During this time period, all of the PBI depressions were not printed on the HSP. This problem is under investigation.

Time: 16/0816Z

Problem: The MAD TMP faulted numerous times.

Impact/Resolution: The DGEN interface was delayed until later in the count. MAD ran diagnostics and found a bad inhibit current diverter problem.

Time: 16/0922Z

Problem: Indicator lights were flashing on the TIC console.

Impact/Resolution: No significant impact since console functions were not affected. The problem was isolated to the "A" system CP adapter.

Time: 16/1002Z

Problem: MIL observed a change in the two special function set locations that they were requested to monitor.

Impact/Resolution: MIL reloaded from the systems tape.

Time: 16/1045Z

Problem: MIL observed a change in the two special function set locations.

Impact/Resolution: MIL reloaded from fault tape.

Time: 16/1343Z

Problem: Net 6 from CYI was very noisy and was dropping in and out.

Impact/Resolution: No data was lost. Net 6 was restored after it was determined that CYI was transmitting a weak signal to the COMSAT.

B. July 17, 1969 (F+1 day)

Time: 17/0152Z

Problem: Bad DTU at CRO.

Impact/Resolution: No data was lost as GDS and HSK were in acquisition. TLM data from CRO on Net 4 (Format 7) was lost for approximately 1 hour and 20 minutes.

Time: 17/0514Z

Problem: GWM TMP faulted.

Impact/Resolution: HSK data was being processed so no data loss occurred. Auto fault load recovery restored the data from GWM.

Time: 17/0521

Problem: The HAW TMP went into fault load recovery without the fault light indication.

Impact/Resolution: No data was lost as HSK data was selected.

Time: 17/0554Z

Problem: Intermittent data was received from GSFC.

Impact/Resolution: Data dropouts were experienced for about 45 minutes due to wide band data line problems.

Time: 17/0801Z

Problem: Biomed subcarriers from HSK and GWM were lost.

Impact/Resolution: Approximately 3 minutes of data was lost. The data was restored before the Comm Manager could isolate the problem.

Time: 17/1345Z

Problem: CMC words 45B and 95B from MAD contained a fill pattern.

Impact/Resolution: About 10 seconds of data was lost while Format 7 was removed and reread from program tape (normal format change). This restored valid data.

Time: 17/2031Z

Problem: GSFC CP had low speed buffer queues building up.

Impact/Resolution: Data was lost for 3 minuites while a recycle was accomplished.

C. July 18, 1969 (F+2 days)

Time: 18/0035Z

Problem: GDS computer faulted.

Impact/Resolution: A 2 minute data loss occurred while an auto load recovery was accomplished.

Time: 18/0331Z

Problem: Dropouts for 2 minutes in high speed data from GSFC.

Impact/Resolution: Modems on GW 58526 were changed in Houston and the problem cleared.

Time: 18/0630Z

Problem: Two minutes of biomed data from HSK was lost.

Impact/Resolution: The decom that was driving the VCO did not get locked up during a switch from LBR to HBR.

Time: 18/0955Z

Problem: Aeromed data was not received at the Aeromed Console.

Impact/Resolution: The Aeromed console was configured improperly. The Commander was selected on two different routes.

Time: 18/1048Z

Problem: MAD TMP faulted.

Impact/Resolution: No data loss; MCC telemetry processing was handed over to HSK. MAD accomplished a fault recovery.

Time: 18/1200Z

Problem: The EKG's were reversed from MAD due to site error.

Impact/Resolution: MAD corrected the configuration when informed.

Time: 18/1617Z

Problem: WBD line GP 58526 from GSFC was intermittent.

Impact/Resolution: Three minutes of intermittent data was received until a switch was made to GP 58527.

Time: 18/2047Z

Problem: ACN TMP faulted.

Impact/Resolution: No data loss occurred as GDS was selected for processing at MCC. Auto fault load recovery restored the ACN data.

D. July 19 (F+3 day)

Time: 19/1050Z

Problem: The ACN TMP faulted.

Impact/Resolution: The TMP would not recover with the fault recovery. A complete reload was required to clear the problem.

Time: 19/1140Z

Problem: The ACN TMP faulted twice in 6 minutes.

Impact/Resolution: No data loss occurred as MAD was selected as data source at MCC. After the second fault, ACN configured the computers in reverse. The problem was later resolved to be a bad memory stack.

Time: 19/1638Z

Problem: Intermittent data from GSFC.

Impact/Resolution: Data modems were switched at MCC and data became solid.

E. July 20, 1969 (F+4 day)

Time: 20/1312Z

Problem: MAD TMP faulted.

Impact/Resolution: Auto recovery was performed without significant data being lost.

Time: 20/1804Z

Problem: Loss of CSM data from MAD.

Impact/Resolution: A momentary data loss was experienced while handing over to MIL. The problem appeared to be in the narrow band signal conditioner. When the wide band signal conditioner was selected, solid data was received.

Time: 20/1850Z

Problem: Wide band signal conditioner failed at ACN. The narrow band signal conditioner had failed at 1404Z, therefore, decom #3 became red at this time.

Impact/Resolution: No data loss occurred as the decom was configured for CSM-FM and no dump support was required at this time.

F. July 21, 1969 (F+5 day)

Time: 21/0829Z

Problem: HSK decom #2 narrow band signal conditioner was marginal.

Impact/Resolution: MCC Telemetry processing was handed over to GWM while HSK switched decoms.

Time: 21/1358Z

Problem: No LM decom output at CRO.

Impact/Resolution: No data loss occurred as CRO was not selected as the data source. The ALSEP buffer plugs were not removed on site.

Time: 21/1440Z

Problem: Nets 4 and 6 from ACN were lost.

Impact/Resolution: MCC Telemetry processing was handed over to MAD. A patching error was then corrected at ACN.

Time: 21/1730Z

Problem: Telemetry data was lost at MCC for approximately 1 minute.

Impact/Resolution: Data loss was due to an MCC CP problem.

Time: 21/2014Z

Problem: LM data was lost from MAD.

Impact/Resolution: Resolved to be an error in procedure at the site. The data bandwidth demodulator switch was set incorrectly. Handover to ACN was accomplished to restore data.

G. July 22, 1969 (F+6 day)

Time: 22/0518Z

Problem: Loss of subframe sync on both lines from GDS.

Impact/Resolution: No data loss occurred as GWM was selected as data source. The GDS M&O reported that each time the time search routine was used it caused the telemetry data to go bad (no frame counts).

Time: 22/0525Z

Problem: Unable to handover LM data to GDS from GWM.

Impact/Resolution: GDS was deselected from Module 19 and displayed on module 23 on the Telemetry console. The handover was then accomplished successfully. When GDS was moved back to module 19, no problem was encountered in selecting vehicles for decom.

Time: 22/0710Z

Problem: HSK had a marginal parametric amplifier.

Impact/Resolution: Static data was shipped from HSK for approximately 4 minutes. No data was lost as data was selected from HAW for processing at MCC.

Time: 22/1135Z

Problem: Subframe sync was lost on all TLM data from GSFC.

Impact/Resolution: About 30 seconds of data was lost. GW 58526 was set out and data became solid.

Time: 22/1218Z

Problem: Lost all TLM data.

Impact/Resolution: Six minutes of data was lost due to PBT's being improperly configured in Houston. Reconfiguration cleared the problem.

H. July 23, 1969 (F+7 day)

Time: 23/0042Z

Problem: Lost GOSS 7 and 10.

Impact/Resolution: Approximately 30 seconds of biomed data was lost before GSFC restored the lines.

Time: 23/0530Z

Problem: Telemetry data was lost at MCC for approximately 2 minutes.

Impact/Resolution: Data loss was due to an MCC CP problem.

Time: 23/1532Z

Problem: MAD TMP faulted.

Impact/Resolution: Approximately 3 minutes of data was lost before handing over to ACN, as ACN was not locked up due to low signal strength. Indications are that this was a memory problem that had been recurring.

Time: 23/2158Z

Problem: GDS TMP faulted.

Impact/Resolution: About 3 seconds of data was lost before handing over to MAD.

Time: 23/2201Z

Problem: GDS TMP faulted.

Impact/Resolution: About 3 seconds of data was lost before handing over to MAD.

Time: 23/2249Z

Problem: Net 6 was out from GDS.

Impact/Resolution: Approximately 3 minutes of data was lost while determining the problem and changing to a legal combination to allow format 8 to be shipped.

I. July 24, 1969 (F+8 day)

Time: 24/0231Z

Problem: Unable to select any data for decom.

Impact/Resolution: Three minutes of data was lost before an MCC CP recycle cleared the problem. During a playback from ALDS all capability to select vehicles for decom was lost. In addition, ALDS timed out with valid data input to the MCC CP. All MSFN data was displayed and updated properly. The CP dumped core and this problem has been identified as a software problem. An errata has been generated to correct the problem.

TABLE 7

PLAYBACK SUMMARY

DATE/TIME	STATION	PLAYBACK TYPE	LENGTH	DATA QUALITY	REMARKS
16/1810Z	GDS	R/T FMT 9 FM/FM	4 minutes	Good	None
16/1830Z	GDS	FM/FM	4 minutes each	Good	Formats 1, 2, 3, 4, 5 and 10 were play back.
16/1944Z	GDS	CSM PM HBR FMT 9	3 minutes	Good	None
16/2043Z	GDS	FMT 13 - IU	5 minutes	Good	None
16/2127Z	GDS	FMT 7 & 9 CSM PM	20 minutes	Good	None
16/2201Z	GDS	FMT 307 & 309 CSM-FM	12 minutes	Good	None
17/1627Z	MAD	CSM-PM FM/FM Contingency	3 minutes each	Good	FMTS 1, 2, 4, 5 & 10 were playback
17/2317	MAD	CSM-PM HbR FM/FM FMT 18	98 minutes	Good	None
18/0208Z	GDS	CSM-PM	6 minutes	Excellent	None
18/1657	MAD	CSM-PM FM/FM FMT 18	58 minutes	Good	None

DATE/TIME	STATION	PLAYBACK TYPE	LENGTH	DATA QUALITY	REMARKS
19/1756Z	MAD	CSM FMTS 107 & 109 FM FMT 9	8 minutes	Good	None
19/1756Z	MAD	FM FM FMTS 1, 2, 3, 4, 5, 10	8 minutes each	Good	None
19/1756Z	ACN	FMT 110 R/T	8 minutes	Good	None
19/1916Z	ACN	Biomed Dump	7 minutes	Good	None
19/2122Z	ACN	DSE Dump FMTS 7 & 9	26 minutes	Good	None
19/2239Z	GDS	DSE Dump LOI 2	33 minutes	Good	None
19/2316Z	GDS	FM/FM FMT 1 thru 5 & 10	29 minutes	Good	None
19/2323Z	HAW	Biomed LOI 2 dump	3 minutes	Good	None
20/0115Z	GDS	FM/FM FMT 18 CSM-PM	23 minutes	Good	None
20/0133Z	GDS	CSM-PM LBR FMTS 7 & 9	9 minutes	Good	None
20/0325Z	GDS	FMT 5 LM-PM D/U Voice	24 minutes	Good	None
20/0359Z	GDS	FM/FM 16 CSM-PM	20 minutes	Good	None

DATE/TIME	STATION	PLAYBACK TYPE	LENGTH	DATA QUALITY	REMARKS
20/0435Z	ACN	CSM-FM DSE Dump LOI 1 FMT 107 & 109	16 minutes	Good	None
20/0525Z	HSK	FM/FM FMT 16	10 minutes	Good	None
20/0530Z	GDS	CSM/PM FMT 309	25 minutes	Good	None
20/0555Z	GDS	LM/PM FMT 205	20 minutes	Good	1 playback from MARS (210) and one from the 85
20/0630Z	GDS	FM/FM FMT 16	10 minutes	Good	None
20/1120Z	HSK	FM/FM FMT 16 DSE Dump	10 minutes	Good	None
20/1442Z	ACN	LM EMOD	1 minute	Good	All banks valid
20/1509Z	ACN	CSM	31 minutes	Good	None
20/2135Z	ACN	LM EMOD	4 minutes	Good	None
21/0106Z	HAW	CSM Dump FMT 109	7 minutes	Good	Lunar Rev 16
21/1240Z	MAD	Voice P/B	25 minutes	Noisy low level	LOI 1

DATE/TIME	STATION	PLAYBACK TYPE	LENGTH	DATA QUALITY	REMARKS
21/2233Z	MAD	CSM Dump FMT 309	49 minutes	Good	None
21/2241Z	MAD	CSM Dump	47 minutes	Good	None
22/0056Z	BDA	LM-EMOD	2 minutes	Good	All banks valid
22/0236Z	GDS	CSM P/B	47 minutes	Good	None
22/0300Z	MAD	DSE Dump Voice	9 minutes	Good	None
22/0511Z	GDS	CSM DSE Dump FMT 9 R/T FMTS 1, 2, 3, 4, 5, 10 & 12	3 minutes & 20 seconds	Good	None
22/0810Z	GDS	Voice P/B	15 minutes	Weak but useable	TEI Dump
22/0900Z	GDS	CSM-PM FMT 107 & 109	7 minutes	Good	None
22/0912Z	GDS	FM/FM FMT 11 CSM-PM	54 minutes	Poor	Replayed numerous times because there was not solid lock on A/G decom.
22/2117Z	MAD	CSM R/T PM FMT 307	7 minutes	Good	None

DATE/TIME	STATION	PLAYBACK TYPE	LENGTH	DATA QUALITY	REMARKS
22/2147Z	MAD	CSM/PM FMT 307 & 309	7 minutes	Good	None
22/2229Z	MAD	CSM PM FMTS 307 & 309	11 minutes	Good	None
22/2257Z	MAD	CSM-PM FMTS 307 & 309	11 minutes	Good	None
24/0200Z	ALDS	LM-PM	13 minutes	Good	This playback was repeated 3 times and terminated at 24/0244Z.

3.5 TRACKING

3.5.1 Trajectory data from the USB and C-Band systems was excellent. Doppler biases were minimum and time synchronization was very good. There were no major data losses or procedural problems which had significant mission impact. The major anomalies are summarized below.

3.5.1.1 The Mercury CDP was unable to support during the TLI burn; consequently high and low speed trajectory data was not provided by the MER. The problem originated as a flexure monitor system failure which impacted the CDP program, and resulted in the CDP failing due to a procedural error.

3.5.1.2 An attempt was made during the mission to reduce low speed data traffic by having the sites change to a 1 per 10 second data sample rate. This resulted in a major GSFC CP problem since the CP program was not compatible with the sample rate. A return to the 1 per 6 second sample rate was accomplished.

3.5.1.3 Several sites experienced USB power amplifier failures during the mission. No significant data losses occurred due to backup systems and/or sites; however, these failures were widespread and an overall appraisal of these subsystems should be conducted by GSFC.

3.5.1.4 The Computer-Aided-Analysis-System operated by the Information Systems Division provided local masking data for this mission. This information was accurate and helpful, but the lead time for this information will have to be reduced prior to Apollo 12.

3.5.2 The following anomalies were noted during the mission and are listed by GMT day.

A. July 16, 1969 (F-0 day)

Time: 16/1100Z

Problem: MER CDP RED

Impact/Resolution: No impact as the system was operational at 16/1200Z. No resolution at this time.

Time: 16/1333Z

Problem: MIL S-Band angles bad.

Impact/Resolution: Approximately 30 seconds of data was lost until angles improved. MIL reported that receivers were saturated.

Time: 16/1334Z

Problem: GBM data not 2-way.

Impact/Resolution: Approximately 15 seconds of data was lost. Operator error was suspected.

Time: 16/1338Z

Problem: Uplink lock lost with the spacecraft.

Impact/Resolution: Uplink lock was lost with the spacecraft from 00:06:00 GET until 00:06:40 GET. The loss of uplink lock was due to GBM turning of their transmitter 30 seconds prior to the nominal handover time of 00:06:30 GET. GBM reacquired the downlink at 00:06:20 GET.and BDA obtained uplink lock at 00:06:40 GET.

Time: 16/1338Z

Problem: First 30 seconds of BDA data after handover reflected not 2-way.

Impact/Resolution: Approximately 30 seconds of data was lost. Operator error was suspected.

Time: 16/1438Z

Problem: TAN data did not agree with current ephemeris.

Impact/Resolution: TAN went off track midway through pass. After four attempts at reacquisition, valid range was acquired. TAN reported at 1852Z that the first threshold was misadjusted and caused false lock.

Time: 16/1519Z

Problem: GYM data tagged CSM while tracking the IU.

Impact/Resolution: No significant impact. Data was erroneously tagged IU by USB operator.

Time: 16/1609Z

Problem: MER high speed data not received at MCC.

Impact/Resolution: MER confirmed output of data at 1611Z. GSFC Comm Manager reported he could not lock on data. Data was received at 1616Z. A 30 second dropout occurred at 1617Z after which the MER CDP faulted invalidating all trajectory data from MER. After the HAW AOS announcement, handover was made and HAW data was used.

NOTE: MER reported that a problem in flexure monitor equipment may have invalidated all trajectory data.

Time: 16/1800Z

Problem: All C-Band "DD" (GSFC only) SIVB trajectory data routed to MCC.

Impact/Resolution: This data tied up the eight GSFC/MCC data lines and prevented receipt of CSM trajectory data. Current indications are that spurious characters either prior to the "DD" header or after the EOM of the previous site caused this data to be routed to MCC.

Time: 16/1859Z

Problem: MAD lost power to prime hydraulic system.

Impact/Resolution: MAD handed over to MAD-X and no data was lost. A faulty heat exchanger motor was replaced and the system was operational at 17/0952Z.

Time: 16/1915Z

Problem: IU downlink shift in frequency.

Impact/Resolution: GDS-X reported seeing a shift in downlink frequency causing a momentary dropout of 2-way lock.

Time: 16/1930Z

Problem: GDS data rejected by the RTCC.

Impact/Resolution: GDS data was rejected by the RTCC between 1930Z to 1959Z. GDS checked data quality bits but did not find the problem. The hardcopy on TTY showed angles set to bad. Angles were set to good and data was accepted starting at 1959Z.

Time: 16/1940Z

Problem: HAW low speed data not received at MCC.

Impact/Resolution: HAW was transmitting C-Band to GSFC on their TTY line prior to a S-Band data commitment. They evidently did not put a SOM on the S-Band when the data source was switched from C-Band to S-Band. A new SOM at 1948Z enabled data to the RTCC.

Time: 16/2139Z

Problem: CAL and GTK C-Band data coming to MCC.

Impact/Resolution: No impact. DD header did not prevent data from coming to MCC. Goddard Comm set out those lines to clear the problem. No resolution.

Time: 16/2335Z

Problem: MSFN released from IU support.

Impact/Resolution: Final signal strength reading was minus 169 DBM at GDS-X. GET of termination was 10:03.

B. July 17, 1969 (F+1 day)

Time: 17/0030Z

Problem: TTY data from GSFC was delayed.

Impact/Resolution: The delay in low speed data appeared to be building at a rate of 1 minute per hour of data transmission.

No resolution at this time.

Time: 17/0158Z

Problem: HAW doppler bias of approximately .125 doppler cycle.

Impact/Resolution: HAW data not processed at MCC due to out of limits bias. HAW requested to go to system 2 for further checking. Problem cleared prior to next support period; cause is unknown.

Time: 17/0400Z

Problem: CRO 29-point acquisition message received garbled.

Impact/Resolution: No acquisition data on station. Acquisition messages were retransmitted. No resolution.

Time: 17/0617Z

Problem: Lost all tracking data sources.

Impact/Resolution: All tracking data was lost for approximately 4 minutes. Problem was caused by GSFC switching computers. All tracking data sources were on line at 0621Z.

Time: 17/0630Z

Problem: MCC not receiving low speed data from HSK.

Impact/Resolution: Tracking data from HSK was lost for 6 minutes. The problem was attributed to a communications line failure which was corrected at 0636Z.

Time: 17/0706Z

Problem: MCC not receiving low speed data from HSK.

Impact/Resolution: Tracking data from HSK was lost for 6 minutes. Problem was isolated to a communications dropout between Goddard and Canberra. Data was back on line at 0712Z.

Time: 17/0847Z

Problem: GWM system 1 ranging system red.

Impact/Resolution: No impact as GWM switched to system No. 2. Problem was due to erratic clock timing and was cleared by 17/0908Z.

Time: 17/1140Z

Problem: MOC down.

Impact/Resolution: The MOC went down as a result of an RTCC software problem. After coordination with FIDO, Network, Track, Data Select and Select Support, all sites were changed to a data sample rate of 1 sample every 10 seconds vice 1 sample every 6 seconds. This reduced the data input to MCC by approximately one-third.

Time: 17/1213Z

Problem: MAD, MAD-X and CYI acquisition data invalid.

Impact/Resolution: No impact. Invalid acquisition data was transmitted when the MOC was lost at 17/1140Z. Valid acquisition data was transmitted to the effected sites prior to AOS.

Time: 17/1520Z

Problem: TEX power amplifier red.

Impact/Resolution: No impact since TEX was scheduled for passive support. The power amplifier was declared green at 17/1525Z

Time: 17/2031

Problem: GSFC CP recycle.

Impact/Resolution: Impact was a total loss of data until 17/2059Z. All acquisition messages were lost during the recycle and had to be retransmitted. This problem was due to an earlier change in tracking data sample rates being sent from the sites.

Time: 17/2248Z

Problem: GSFC CP and MSFN sites reverted back to 1 sample per 6 seconds for TTY data.

Impact/Resolution: Impact loss of TTY data for 1 minute from all sites.

C. July 18, 1969 (F+2 day)

Time: 18/0629Z

Problem: CRO paramp red, can support.

Impact/Resolution: The paramp was unstable. No significant impact since CRO supported with reduced gain of 3 db until LOS and after LOS replaced Klystron.

Time: 18/0824Z

Problem: HSK-X system No. 3 and 4 power amplifiers red.

Impact/Resolution: Unable to track two-way and no command capability. No immediate impact as they were a 3-way site, however, uplink capability was lost. The failure was due to a short which caused some damage to the system 3 power supply and total loss of the system 4 power supply. System 3 was green at 18/0917Z. System 4 was operationzl at 19/1622Z.

Time: 18/1027Z

Problem: CRO data in intercept at MCC.

Impact/Resolution: CRO data was lost for approximately 2 minutes until new SOM was initiated at CRO.

Time: 18/1023Z

Problem: GDS data tagged LM being received at MCC.

Impact Resolution: GDS was performing system checks during a release period and inadvertently shipped data to MCC. GDS was requested to terminate data.

Time: 18/1120Z

Problem: All 3-way sites had a 20 cycle bias in doppler.

Impact/Resolution: MAD-X was the 2-way site and had come up with the wrong transmitter frequency. It was corrected with no loss of data.

Time: 18/1242Z

Problem: MAD-X system 3 power amplifier failed.

Impact/Resolution: Lost all tracking data from MAD-X. The circuit breaker at the motor generator tripped causing a power amplifier failure. The problem was caused by excessive heat. The temperature outside was 105 degrees. The circuit breaker was reset and cooling procedures were initiated.

Time: 18/1347Z

Problem: ACN data had large biases on every other data point.

Impact/Resolution: No significant impact. The ACN M&O advised that they had erroneously configured for dual TDP operation.

Time: 18/1350Z

Problem: MAD-X experienced a momentary power amplifier failure.

Impact/Resolution: The beam voltage overcurrent circuit breaker tripped. It was reset with no loss of data.

Time: 18/2138Z

Problem: BDA low speed tracking data lost.

Impact/Resolution: BDA tracking data was not received at MCC. Problem was due to a faulty TTY line. Data was back on line at 2145Z.

D. July 19, 1969 (F+ 3 day)

Time: 19/0212Z

Problem: CRO 1218 red.

Impact/Resolution: The program track capability was lost until the system went green at 19/0305Z

Time: 19/1553Z

Problem: ACN lost satellite interface for low speed data.

Impact/Resolution: Impact was loss of approximately 5 minutes of low speed data while reconfiguring to HF. ACN was back on the satellite at 19/1608Z

Time: 19/1714Z

Problem: MAD-X lost the 1218 computer at 1 minute prior to AOS.

Impact/Resolution: No impact. The site went to the back up mode for acquisition. The 1218 computer was recycled and the problem cleared.

Time: 19/1815Z

Problem: GDS-X system 3 power amplifier failed.

Impact/Resolution: Impact was a lack of confidence in system 3. The power amplifier failed at least once a day for 3 days. GDS switched to system 4 for the remainder of the view period.

Time: 19/2011Z

Problem: MAD-X low speed tracking data "good/bad" angle switch set to "bad."

Impact/Resolution: MOC could not process data. MAD-X set the switch to "good" and data was successfully processed by the MOC.

E. July 20, 1969 (F+4 day)

Time: 20/0358Z

Problem: HSK-X tracking data in dual TDP mode.

Impact/Resolution: No impact. HSK-X switched to single TDP mode.

Time: 20/0452Z

Problem: HSK reported that pointing data supplied to Parkes was in error.

Impact/Resolution: No impact. HSK supplied pointing data to Parkes. MCC pointing data had the wrong sign.

Time: 20/1300Z

Problem: ACN dual TDP data was rejected at MCC.

Impact/Resolution: ACN data was lost for approximately 10 minutes. There was no LM active signal for system 1 to auto-track. The site was in program track on system 2 and did not have the "good/bad" switch set to good. ACN set the switch to "good" and data was processed normally.

Time: 20/1630Z

Problem: ACN lost satellite interface for low speed data.

Impact/Resolution: Impact none. The site switched to HF for low speed tracking data.

Time: 20/1935Z

Problem: HSK-X data showing 2-way rather than 3-way.

Impact/Resolution: No impact. HSK-X was instructed to change their data to reflect 3-way.

Time: 20/1948Z

Problem: Sites unable to maintain 2-way lock.

Impact/Resolution: Sites were unable to maintain 2-way lock from acquisition of the LM at 102:16 GET until the powered descent YAW maneuver was completed at 102:38 GET. Sites were able to maintain lock from the completion of this manuever through LM touchdown. At present, the problem appeared to be due to maksing of the LM steerable antenna by an RCS thruster quad and/or multipath conditions.

Time: 20/2051Z

Problem: GDS lost hydraulics.

Impact/Resolution: Site was unable to autotrack. GDS set brakes on antenna and maintained lock until problem cleared at 2052Z. No resolution at this time.

F. July 21, 1969 (F+ 5 day)

Time: 21/0344Z

Problem: ANG TDP red.

Impact/Resolution: No significant impact. Computer was intermittently outputting all zero's, TDP was operational at 20/1318Z.

Time: 21/0417Z

Problem: GWM 1218 faulted.

Impact/Resolution: No impact as computer was reloaded and cycling at 0420Z.

G. July 22, 1969 (F+6 day)

Time: 22/0234Z

Problem: HSK paramp red can support.

Impact/Resolution: No impact since the problem occurred after occultation. The problem was in the Klyston pump power to the paramp and was corrected at 22/0250Z.

Time: 22/0345Z

Problem: MCC CP recycled to clear RTCC buffers.

Impact/Resolution: The impact was the loss of low speed data while a new start of message was initiated at the sites. Approximately 2 minutes of data was lost.

Time: 22/0553Z

Problem: CP recycled to put both machines in sync.

Impact/Resolution: Two minutes of data was lost while a new SOM was put on low speed data at the sites.

Time: 22/1730Z

Problem: CP faulted.

Impact/Resolution: The online and standby CP's were recycled to clear the problem and regain sync. All acquisition messages had to be retransmitted just prior to the LM ascent phase.

Time: 22/1800Z

Problem: MOC unable to transmit acquisition data.

Impact/Resolution: The MOC was in a high speed processing mode and did not ship acquisition messages on schedule. Acquisition messages were forced to all sites after the ascent burn.

Time: 22/1936Z

Problem: MAD lost cooled paramp.

Impact/Resolution: No loss of data. MAD switched to warm paramp with no problems. No resolution at this time.

Time: 22/2130Z

Problem: MCC CP faulted.

Impact/Resolution: Data processing was switched to the standby CP and no data was lost. Acquisition messages were lost during the switch and had to be retransmitted.

Time: 22/0850Z

Problem: HSK-X system 3 had faulty range tally.

Impact/Resolution: HSK-X data contained a 250 yard bias in range data. HSK-X switched to system 4 and the bias cleared.

Time: 22/1426Z

Problem: ACN 1218 red, cannot support.

Impact/Resolution: ACN was unable to use program track mode. The 1218 computer was operational at 22/1747Z.

Time: 22/1442Z

Problem: MAD-X system 3 power amplifier was intermittently dropping out.

Impact/Resolution: The system 3 power amplifier was dropping out due to activation of the beam voltage interlock. MAD suspected that the interlock was being activated due to excessive heating. Steps were taken to reduce the temperature in the area, including bringing down the system 4 power amplifier. No further problems were experienced.

Time: 22/1445Z

Problem: BDA power amplifier red, cannot support.

Impact/Resolution: No impact since BDA was not a backup site. Problem was due to arcing in the beam voltage power supply. The system was operational at 22/1714Z.

Time: 22/2129Z

Problem: All sites experienced LOS.

Impact/Resolution: INCO did not accomplish an antenna switch. Track was lost for 48 minutes.

Time: 22/2353Z

Problem: All sites experienced LOS.

Impact/Resolution: INCO did not accomplish an antenna switch. Track was lost for 8 minutes.

H. July 23, 1969 (F+7 day)

Time: 22/0000Z

Problem: CP faulted.

Impact/Resolution: All acquisition messages being transmitted were lost and had to be retransmitted.

Time: 23/0253Z

Problem: HSK cooled paramps red.

Impact/Resolution: Impact was degradation of signal-to-noise ratio due to substitution of warm paramps for cooled paramps. ETO was post-mission.

Time: 23/0530Z

Problem: MCC CP down due to low speed program fault.

Impact/Resolution: Impact was loss of low speed data for approximately 5 minutes. All acquisition messages had to be retransmitted. The CP was up at 0532Z.

Time: 23/0547Z

Problem: GWM 1218 faulted.

Impact/Resolution: GWM was unable to use program track mode. System was operational at 23/0706Z.

I. July 24, 1969 (F+8 day)

Time: 24/0231Z

Problem: MCC CP failed.

Impact/Resolution: Impact was loss of low speed data to the MOC for approximately 5 minuaes while a new start of message was put on incoming data. Acquisition messages had to be forced for all sites in view.

Time: 24/1539Z

Problem: RED CDP red for timing and loading acquisition data.

Impact/Resolution: The ship was unable to load IRV's for acquisition information. The site went red, can support at 1604Z and was able to acquire and track during reentry.

3.6 COMMUNICATIONS

3.6.1 The following is a chronological resume of significant communications events by date:

A. July 16, 1969 (F-0 day)

Time: 16/1314Z

Problem: Failure in the leased line extension of MSFN wide band data from Building 30 to Building 12.

Impact/Resolution: Building 12 reported they were not receiving MSFN data on local leased wide band lines 1GW2014 and 1GW2015. TELCO found two faulty amplifiers and restored the circuit to operation at 1742Z. There was no mission impact since the Wide Band Data interface between GSFC and MCC was fully operational during this period.

Time: 16/1344Z

Problem: Low level circuits from Canary Island.

Impact/Resolution: At 1344Z and continuing for approximately 1 minute, Net 6 (from CYI) experienced momentary dropouts. Net 6 was restored by GSFC. At 1352Z all CYI circuits were marginal. The problem was traced to a low power output at the CYI (COMSAT) ground station. The problem was corrected at 1401Z by increasing the power level at the COMSAT ground station at CYI.

Time: 16/1444Z

Problem: Low speed C-band data with "GSFC only" header being transmitted to MCC.

Impact/Resolution: This data, which should have been terminated at GSFC, tied up the eight GSFC/MCC low speed data lines and prevented the receipt of CSM trajectory data. The GSFC Comm Manager suspected that spikes or "hits" on the data lines caused a change in the teletype bit formation; however, this has not been verified. Post mission testing will be conducted by GSFC to isolate this problem.

Time: 16/1608Z

Problem: Inability to receive Net 5 tracking data from MER.

Impact/Resolution: Problem was attributed to the trajectory computer onboard the MER rather than a communications problem.

Time: 16/1722Z

Problem: Nets 4 and 6 from HAW and CRO lost.

Impact/Resolution: No impact since the spacecraft was not in view. The failure was traced to a bad link between Oakland and Jamesburg, California and was cleared at 1802Z.

B. July 17, 1969 (F+1 day)

Time: 17/0446Z

Problem: Primary and alternate wide band data lines experienced intermittent errors.

Impact/Resolution: No major data losses were experienced although momentary outages were encountered due to configuration changes. The primary line was generally unusable between 0446Z and 0652Z due to mircowave fades in the area of Greenbelt, Maryland. Also, the alternate line, transmit side to GSFC, was out between 0547Z and 0641Z due to a radio unit failure in Jasper, Alabama. The primary line was set in to restore the transmit side to GSFC.

Time: 17/1229Z

Problem: Loss of ANG Net 4.

Impact/Resolution: The command interface with ANG and one telemetry format was lost for approximately 1 minute. Net 4 was restored on a make good circuit at 1230Z. The basic Net 4 circuit came clear while checking and was normalled at 1237Z.

Time: 17/1800Z

Problem: Primary wide band data line experienced errors on receive side at MCC.

Impact/Resolution: No significant data losses were experienced although no backup line was available

during the period. After several hours of line testing and configuration changing, the problem was isolated to the "A" modem on the primary line at MCC. At 17/2004Z the primary line was operational using the "B" modem at MCC. The "A" modem was turned over to Telco and was subsequently repaired at 17/2358Z.

Time: 17/2031Z

Problem: GSFC CP faulted due to queue val hand-ups.

Impact/Resolution: All telemetry, tracking and command data flow was lost due to the GSFC CP fault. A CP recycle was accomplished; however, this did not clear the problem. Subsequently, the problem was isolated to a change in the MSFN low speed data sample rate from 1 sample per 6 seconds to 1 sample per 10 seconds. This change caused the eight GSFC/MCC low speed circuits to block all other output routines from the CP drum during the last 4 seconds of each sample period. The problem was cleared at 17/2045Z after GSFC made a core change to accomodate the new sample rate.

C. July 18, 1969

Time: 18/1015Z

Problem: Excessive errors were experienced on the primary wide band data circuit (GW58526).

Impact/Resolution: No significant impact since data was switched over to the alternate wide band line (GW58527). At 1036Z the primary line was set into the CP and functioned properly until 1051Z when errors were again reported. At 1059Z, the primary line was again set in to the CP and no further trouble was encountered. Problem was due to mocrowave fades in the area west of Greenbelt, Maryland.

Time: 18/1407Z

Problem: Music heard on GOSS Conference.

Impact/Resolution: No significant impact since the level of the music was very low and did not interfere with communications on Goss Conference. The music cleared before the source could be isolated.

Time: 18/1618Z

Problem: Primary wide band data line lost.

Impact/Resolution: No significant data losses since the alternate line was good during the period. The problem was isolated to a bad "A" modem at MCC. A new modem was installed and the primary line was set in at 18/2159Z.

D. July 19, 1969 (F+3 day)

Time: 19/0500Z

Problem: The primary Wide Band Data line would not operate reliably with the "B" modem at MCC.

Impact/Resolution: No impact since the primary line functioned properly with the "A" modem at MCC and the alternate line was good. A circuit board was replaced in the "B" modem at 20/0225Z and the problem cleared.

Time: 19/1044Z

Problem: Downlink voice from HSK not being received at MCC.

Impact/Resolution: Spacecraft voice was lost at MCC for approximately 6 minutes. HSK confirmed that the site was receiving spacecraft voice. GSFC also confirmed that spacecraft voice was being received at GSFC. Spacecraft voice was received at 19/1050Z and no further problems were experienced. Subsequently, a tape playback of Goss Conference revealed that spacecraft voice was received at MCC but was almost undetectable due to noise and low signal strength. No resolution at this time.

Time: 19/2250Z
P
Problem: The GOSS Conference extension to astronaut homes experienced cross talk from the PAO Release circuits.

Impact/Resolution: No mission impact. The problem was isolated to a faulty bridge in Building 2 which caused intermodulation between the two circuits. The problem was corrected at 20/0115Z.

E. July 20, 1969 (F+4 day)

Time: 20/2100Z

Problem: The primary wide band data line failed.

Impact/Resolution: No mission impact since the CP failed over to the alternate line. The primary line was restored on the TELCO overhead spare at 2108Z. The failure of the primary line was due to a microwave failure between Leesburg and Garden City. The primary circuit was not set in until 21/1207Z because of periodic hits due to thunderstorms in the Leesburg area.

F. July 21, 1969 (F+5 day)

Time: 21/1408Z

Problem: Nets 2, 5 and 6 to MAD lost.

Impact/Resolution: One telemetry format and Net 2 voice was lost from MAD for 2 minutes. The outage was due to a power failure at the Butraigo, Spain COMSAT station. The circuits were restored on cable at 1410Z. At 1458Z, the circuits were again normalled via the COMSAT.

Time: 21/1904Z

Problem: Net 1 to MAD noisy.

Impact/Resolution: No significant impact since GSFC Voice Control restored Net 1 to MAD on another circuit. When the basic Net 1 became usable, Voice Control switched back to it without coordinating with Comm Control at MCC. Consequently, keying checks being conducted with MAD were interrupted and had to be reaccomplished. GSFC was requested to coordinate future circuit reconfigurations with MCC to preclude interference with data flow.

G. July 22, 1969 (F+6 day)

Time: 22/1654Z

Problem: Nets 1, 2, 3, 4 and 6 to ANG lost.

Impact/Resolution: No significant impact since ANG was passive during the period. Nets 1 and 2 were restored by 1657Z and Nets 4 and 6 from ANG were restored at 1659Z. All circuits with ANG were normal at 1715Z. The outage was due to a channel failure in the subcable to ANG.

Time: 22/2245Z

Problem: ALSEP command and telemetry interface with TEX lost.

Impact/Resolution: The ALSEP telemetry and command interface with TEX was lost for approximately 20 minutes. The problem was isolated to a bad CLT at GSFC and was corrected at 22/2306Z.

Time: 22/2343Z

Problem: Numerous circuits between GSFC and MCC lost.

Impact/Resolution: Electrical storms caused a microwave failure between Suitland, Maryland and Greenbelt, Maryland resulting in many MCC-GSFC circuits being interrupted. Mission impact was negligible because of either redundant facilities or restoral actions. All circuits were restored by 23/0044Z. The following is a summary of the affected circuits and restoral action.

GOSS 8 (Comm Order Wire) - Restored on overhead.

GOSS 7 (Biomed) - Restored on backup biomed circuit (GOSS 10).

Alternate MSFN Wide Band Line - Restored at 22/2359Z on the primary line (the TELCO overhead backup spare was functional at the time of outage).

GOSS Conference Backup Circuit - Not restored, however, GOSS 2 was available in the event of GOSS Conference failure.

PAO Release spur to GSFC - Not restored, back to normal at 23/0021Z.

MSR/State Voice Circuit - Not restored, back to normal at 23/0021Z.

Alternate Voice Frequency Telegraph Circuit - Restored on GOSS 3, back to normal at 23/0044Z.

H. July 23, 1969 (F+7 day)

Time: 23/1149Z

Problem: ALSEP telemetry data from CRO not received at MCC.

Impact/Resolution: ALSEP telemetry data from CRO was lost for 2 minutes. Problem was isolated to GSFC where the CRO Communications Line Terminal was inadvertently taken off line. The error was corrected at 23/1151Z.

Time: 23/1544Z

Problem: The alternate wide band data circuit and the primary voice frequency telegraph system (composite teletype) line experienced a momentary dropout.

Impact/Resolution: No significant impact. Upon loss of the primary voice frequency telegraph system (VFTG) an immediate switch was made to the alternate VFTG line. Simultaneous with the above occurrence, the primary wide band data line failed over to the alternate line and back again to the primary line. These outages were only momentary; thus the location and reason for the outages was impossible to isolate. No telemetry data was lost; however, it was necessary for two sites to initiate new start of messages on tracking data.

Time: 23/1615Z

Problem: Wide Band Data from GSFC became erratic after a GSFC CP switch.

Impact/Resolution: At 1615Z GSFC switched CP's to "B" system online and "A" system standby. Simultaneously, the primary wide band data line failed over to the alternate line with no apparent loss of data. The dropout of the primary line was due to the primary line PBT, associated with the "B" CP, being set out when the CP switched occurred. At 1618Z the primary line PBT was set in at GSFC and telemetry data became erratic at MCC. This problem was due to a queue build up at GSFC on the primary line. Approximately 2 minutes of telemetry data was lost until the problem was cleared at 1620Z.

Time:T 23/2142Z

Problem: Low level cross-talk on GOSS Conference.

Impact/Resolution: No significant impact. The air/ground function was swapped from GOSS Conferenced to GOSS Conference backup and the problem was referred to TELCO. The basic GOSS Conference was returned to service at 2154Z. No resolution at this time.

Time: 23/2252Z

Problem: Net 1 to GDS lost.

Impact/Resolution: Net 1 was restored immediately on Net 2 and Net 2 was restored on Net 3. The circuits were returned to their normal configuration at 23/2258Z. The trouble was isolated to a K-Carrier between Austin and Houston, Texas.

I. July 24, 1969 (F+8 day)

Time: 24/0001Z - Recovery

No significant communication problems were experienced.

3.7 AIR/GROUND COMMUNICATIONS

3.7.1 Air to Ground communications support was good throughout the mission. Few significant communication outages were experienced due to equipment failures; however, several communication losses were caused by procedural errors.

3.7.2 The following is a chronological listing of A/G communication anomalies for Apollo 11.

A. July 16, 1969 (F-0 day)

Time: 16/1518Z

Problem: Squeal and echo evident on GOSS Conference.

Impact/Resolution: No loss of communication was experienced. The noise was isolated to Net 1 from the VAN which reported that a relay blocking tool was inadvertently left in the AM key circuit. The problem was corrected at 16/1520Z.

Time: 16/1540Z

Problem: CAPCOM could not uplink through TAN on his first two tries.

Impact/Resolution: TAN was not receiving the CAPCOM's voice on Net 1 due to a circuit failure at London. The circuit was restored at approximately 1542Z.

Time: 16/1641Z

Problem: No downlink voice received from GDS.

Impact/Resolution: Downlink voice was lost for approximately 1 minute until the downlink was handed over to MILA. Initially GDS reported that there was no voice subcarrier from the spacecraft. However, it was later determined that the voice subcarrier presence indicator had failed and that the station comm tech was monitoring good downlink during this period. The downlink voice was not remoted due to GDS's interpretation and understanding of the AS-506 Mission Supplements, paragraph 40.5.4.2 and 40.5.5.

Time: 16/1703Z

Problem: Spacecraft downlink from GDS was distorted.

Impact/Resolution: The downlink voice was readable but distorted until a handover was made to MAD at 1732Z. GDS replaced a suspected faulty cable between the filter data output and the PM voice demod input and experienced no further distortion. GDS was unable to later recreate the problem; however, the site suspected that the cable was attenuating the voice subcarrier input and causing intermittent subcarrier lock.

B. July 17, 1969 (F+1 day)

There were no significant discrepancies this day.

C. July 18, 1969 (F+2 day)

Time: 18/1347Z

Problem: MCC received broken spacecraft voice from MAD.

Impact/Resolution: The Houston Comm Tech queried MAD on the quality of the downlink voice at the input to the VOGAA and output. Subsequently, MAD reported that the input was good but the output from the VOGAA was broken. MAD was instructed to bypass the VOGAA and the problem cleared.

Time: 18/1942Z

Problem: The crew reported that the CAPCOM uplink from MAD was broken.

Impact/Resolution: The uplink was broken due to INCO switching antennas on the spacecraft. Communication with the spacecraft was lost for approximately 2 minutes.

D. July 19, 1969 (F+3 day)

Time: 19/1044Z

Problem: Spacecraft voice remoted from HSK not heard at MCC.

Impact/Resolution: Two downlinks from the spacecraft were copied by HSK and GSFC Voice but not copied by MCC. A handover was made to MAD at 1047Z and communications both ways was loud and clear. A subsequent playback of the MCC Goss Conference recording verified that the downlinks were received at MCC, but they were so weak that it was almost unreadable due to noise and low signal strength.

Time: 19/2217Z

Problem: No spacecraft voice from HAW received at MCC.

Impact/Resolution: Spacecraft voice was lost until GDS remoted downlink voice at 2218Z. No resolution at this time.

E. July 20, 1969 (F+4 day)

Time: 20/0217Z

Problem: Spacecraft voice remoted from GDS noisy.

Impact/Resolution: Downlink communications with the spacecraft was lost for approximately 8 minutes. GDS reported that a faulty receiver #1 power supply was the cause of the noise and intermittent loss of lock during the period.

Time: 20/2141Z

Problem: The LM crew complained about the high noise level on their uplink from GDS

Impact/Resolution: This was caused by weak signal and noise from the CSM downlink causing the VOGAA to break squelch while GDS was operating in the MSFN relay mode. The noise was removed from the uplink by disabling the MSFN relay mode at GDS.

F. July 21, 1969 (F+5 day)

Time: 21/0154 Z

Problem: During EVA, the uplink from the CAPCOM was being returned on the downlink.

Impact/Resolution: A noticeable echo of the CAPCOM's voice was evident on GOSS Conference. The amount of echo varied from none to complete CAPCOM phrases. The exact cause of the echo is not known. However, the Extra Vehicular Communications System or the LM communications system is suspected. At the time GDS was configured for normal LM uplink and downlink; HSK was configured for constant key to allow the CSM to receive the CAPCOM/LM communications.

Time: 21/1921Z

Problem: Air-to-Ground communications with the CSM, through MAD and ACN, was poor during lunar orbit 26 (1921Z - 2057Z).

Impact/Resolution: Communications with the CSM were poor during lunar orbit 26. There is no resolution at this time.

G. July 22, 1969 (F+6 day)

Time: 22/0714Z

Problem: Spacecraft voice from HSK lost.

Impact/Resolution: Spacecraft voice was lost momentarily until GWM was instructed to remote the downlink. The problem at HSK was caused by a faulty paramp.

Time: 22/1707Z

Problem: Spacecraft voice remoted from MAD was distorted.

Impact/Resolution: The Houston Comm Tech queried MAD on the quality of the downlink voice at the input to the VOGAA and output. Subsequently, MAD reported that the input was good but the output was distorted. MAD was instructed to bypass the VOGAA and the problem cleared.

H. July 23, 1969 (F+7 day)

Time: 23/2253Z

Problem: Net 1 lost to GDS.

Impact/Resolution: Net 1 was restored on Net 2 and no communications were lost. At 2258Z GSFC reported all nets to GDS was normal. The net failure to GDS was due to a "K" carrier failure between Austin and Houston.

I. July 24, 1969 (F+8 day)

There were no significant discrepancies this day.

3.8 Onboard Television

3.8.1 Apollo 11 carried the 525 line sequential color camera in the CSM and the slow scan camera on the LM. Both cameras performed exceedingly well and rendered high quality television throughout the mission. The ground support television system performed very well and experienced only minor problems.

3.8.2 The following is a chronological summary of television activity for Apollo 11:

A. July 16, (F-0 day)

Time: 16/1501Z - 16/1505Z

Configuration: Goldstone to receive, record and relay to MCC. MCC and Building 8 to convert sequential video to color and release. MILA to record if camera still on.

Signal Strength: Goldstone 97-98 DBM, MILA not known.

Picture Quality: No usable video at Goldstone - about 40 seconds of discernable TV at MILA.

Operations: Goldstone reported no video lock. Problem was isolated to bad patch cable between the FM demodulator and video equipment. Due to the short period of acquisition the problem was not resolved in real time and the real time television downlink was lost. MILA did receive and record discernable TV for about 30 seconds from their AOS and for about 10 seconds prior to LOS. The television received at MILA between the above times was badly out of focus (due to camera positioning).

B. July 17, 1969 (F+1 day)

Time: 17/0004Z - 17/0017Z

Configuration: Goldstone to receive and record and later relay to MCC. MCC and Building 8 to record, convert sequential video to color and release.

Signal Strength: Goldstone Prime -81 DBM.

Picture Quality: Very good.

Operations: Playback to MCC, color conversion and release completed by 12:29 GET.

Time: 17/1956Z - 17/2050Z

Configuration: Goldstone and Madrid to receive and record. Goldstone to later relay to MCC. MCC and Building 8 to convert sequential video to color and release.

Signal Strength: JPL 210' Facility - -106 DBM
Goldstone Prime - -113 DBM
Goldstone Wing - -110 DBM
Madrid Wing - -109 DBM at best

Picture Quality: Snowy, poor, spacecraft on omni antennas.

Operations: Playback to MCC, color conversion and release completed by GET 36:30. Tape contained about 10 minutes of discernable color television.

Time: 17/2331Z - 18/0005Z

Configuration: Goldstone to receive from JPL 210', record and relay to MCC. MCC and Building 8 to convert sequential video to color and release.

Signal Strength: JPL 210' - -89 - -87 DBM
Goldstone Wing - -95 DBM
Goldstone Prime - -95 DBM

Picture Quality: Excellent

C. July 18, 1969 (F+2 days)

Time: 18/2040Z - 18/2216Z

Configuration: Goldstone to receive from JPL 210' site, record and relay to MCC. MCC and Building 8 to convert sequential video to color and release. Madrid to record and release.

Signal Strength: JPL 210' Facility - 86 DBM
Goldstone Prime - 93 DBM
Goldstone Wing - 93 DBM
Madrid - 94 - 97 DBM (56:04 MAD LOS)

Picture Quality: Excellent at both Madrid and Goldstone. Small burn spot evident in camera.

Operations: Approximately 3 minutes of color was lost due to reloading fresh video tapes from 56:05 to 56:08 GET.

D. July 19, 1969 (F+3 days)

Time: 19/1956Z - 19/2029Z

Configuration: Goldstone to receive from JPL 210' site, record and relay to MCC. MCC and Building 8 to convert sequential video to color and release. Madrid to receive, record and release.

Signal Strength: JPL 210' - 87 DBM
Goldstone Prime - 95 DBM
Goldstone Wing - 95 DBM
Madrid Wing - 97 DBM

Picture Quality: Excellent, burn spot was still evident in camera.

E. July 21, (F+5 days)

Time: 21/0254Z - 21/0758Z

Configuration: Goldstone to receive from JPL 210' site, convert to STD 525 line video, record and relay to MCC; Honeysuckle to receive, convert to STD 525 line video, record and relay to Sidney; Parkes to receive, record and relay to Sidney. Sidney to convert Parkes input to STD 525 line television and relay "best source" to MCC and Australian Television Network. MCC to record and release.

Signal Strength: JPL 210' - -94 DBM
Honeysuckle- not reported
Parkes - -90 DBM

Picture Quality: JPL 210' - Goldstone - Good
Honeysuckle - Very good
Parkes - Excellent

Operations:
109:22 GET - Goldstone
109:24 - Switched to Honeysuckle
109:26 - Switched to Goldstone
109:27 - Switched to Honeysuckle
109:28 - Switched to Goldstone
109:31 - Switched to Parkes at acquisition and remained on that signal until camera was turned off.

F. July 23, 1969 (F+7 days)

Time: 23/0108Z - 23/0126Z

Configuration: GDS to receive, record and relay to MCC; MCC and Building 8 to convert sequential video to color and release; Honeysuckle to receive, record and release if acquisition permits.

Signal Strength: Goldstone Prime - 93 DBM
Goldstone Wing - 93 DBM
Honeysuckle - No acquisition

Picture Quality: Very good

Time: 23/2242Z - 23/2317Z

Configuration: Goldstone to receive, record and relay to MCC. MCC and Building 8 to convert to sequential video to color and release. Madrid to receive, record and release.

Signal Strength: Goldstone - 90 DBM
Madrid Prime - 97 DBM

Picture Quality: Excellent at all sites.

Operations: Camera was turned on and off numerous times.

3.9 M&O Operations

3.9.1 M&O supported Apollo 11 extremely well and experienced only a few minor problems. The following is a chronological resume of M&O problems.

A. July 16-17, 1969, (F-0, F+1 day)

Time: 2105Z - 2109Z

Problem: VSM outputs 141 through 150 were disabled.

Impact/Resolution: Consoles 18, 12 and 47 had one monitor each with overlayed displays. A defective power supply was replaced in the VSM.

Time: 0443Z - 0658Z

Problem: P-tube System III, loop 1 was down.

Impact/Resolution: Carriers could not be delivered to loop 1 stations. Hung carriers were removed from station 3-13.

B. July 17-18, 1969 (F+2 days)

No significant problems were experienced.

C. July 18-19, 1969 (F+3 days)

No significant problems were experienced.

D. July 19-20, 1969, (F+4 days)

No significant problems were experienced.

E. July 20-21, 1969 (F+5 days)

No significant problems were experienced.

F. July 21-22, 1969 (F+6 days)

Time: 0313Z - 0336Z

Problem: L-2 Eidaphor failed.

Impact/Resolution: No TV display was available on the L-2 position. The Xenon lamp was replaced and the Eidophore was placed online at 0336Z.

Time: 0139Z - 0246Z

Problem: ADEG D/TV channel 91 was down.

Impact/Resolution: The DSC display capability was limited when the ADEG channel was down. The converter slide file was replaced in the channel.

G. July 22-23, 1969 (F+7 days)

Time: 1023Z - 1025Z

Problem: DDD rack 83 was down.

Impact/Resolution: TIC's data readouts were lost. Fuses were replaced in the racks.

H. July 23-24, 1969 (F+8 days)

No significant problems were experienced.

4.0 SCHEDULING

4.1 Premission Activities and Utilization Summaries

A. Major Milestones

The MCC resources were placed in an Apollo 11 configuration on May 31, 1969. Apollo 11 software delivery dates were as follows:

April 7, 1969 - CCATS Program Delivery
April 26, 1969 - ALDS Program Delivery
May 15, 1969 - APCU Program Delivery
May 15, 1969 - RSDP Program Delivery
May 28, 1969 - GSSC Program Delivery
May 28, 1969 - RTCC Program Delivery
July 1, 1969 - ALSEP Program Delivery

The following chronological history depicts all Apollo 11 premission testing supported by the MCC. This testing includes all simulations, pad tests, and validation tests conducted by Flight Control and Operations Support.

Major Milestones Summary

April 7	TLM Verification
April 16	TLM Verification
April 26	MCC/MSFN Val 1040 - KSC, ALDS
April 30	MCC Val 601
May 5	Math Model Launch Sim
May 6	MCC/MSFN Val 1040 - KSC, ALDS
May 6 - 7	MCC Val 501
May 9	Math Model SNS (TLI)
May 10	CMS Launch Sim
May 12 - 13	MCC Val 501
May 12	A/G Remoting Test - GSFC, CAL, MER

May 13	CMS Launch Sim
May 14	Internal ALSEP C/O
May 15	CMS SNS (TLI)
May 16	MCC Val 501 (Lunar Activity)
May 19	Math Model SNS (LOI)
May 20	CMS Reentry Sim
May 21	CMS SNS (LOI)
May 22	MCC Val 501
May 24	MCC/MSFN Val 1041.3 - GSFC, MIL; 3040 - KSC
May 25	MCC/MSFN Val 2041 - GSFC, MIL; 2043 - GSFC, KSC, MIL
May 26	Math Model C/O
May 27	Internal ALSEP C/O
May 28	MCC/MSFN ALSEP Val 1051, 2051 - GSFC, MILA
May 28	Math Model SNS (DOI/DES)
May 29	CMS/LMS SNS (DOI/DES)
June 2	MCC/MSFN Vals 1041.3, 1043 - GSFC, MIL ALDS CADFISS, MIL CADFISS
June 3	Math Model SNS (ASC/RNDZ)
June 3	MCC/MSFN Val 1041.1, 1041.2 - GSFC, MIL
June 3	Sim C/O
June 4	Data Playback
June 4	ALSEP Vals 1051, 2051 - GSFC, MIL
June 4	CMS/LMS SNS (ASC/RNDZ)

June 5	Math Model Reentry SNS
June 5	EVA Comm C/O
June 6 - 7	FRT
June 6	EVA Walkthrough
June 7	Comm Compatibility Test (PLSS)
June 9	LM Sim Flight
June 10	Math Model PD Abort SNS
June 10	ALSEP I/F C/O
June 11	ALSEP Vals 1051, 2051 - GSFC, MIL
June 12	CMS LOI SNS
June 13	LMS PD Abort SNS
June 16	Math Model TLC SNS
June 16	MCC/MSFN Vals 1041.1, 1041.2 - GSFC, MIL IU Trajectory - GSFC, MIL, KSC GDS Flyby and Equipment C/O
June 17	Math Model FIDO/BSE
June 18	ALSEP Val 1051, 2051 - GSFC, MIL
June 18	EVA Walkthrough
June 19	ALSEP Qual End to End Tape Play
June 20	ALSEP Qual End to End Test
June 20	CMS/LMS ASC/RNDZ SNS
June 22 - 23	EASEP Sim Deploy and Start Up
June 23	CMS/LMS DOI/RNDZ SNS
June 24	A/G Remoting Test - GSFC, RED

June 24	CMS Reentry Sim
June 25	A/G Remoting Test - GSFC, MIL
June 25 - 26	EVA Sim Walkthrough
June 25	CMS/LMS DOI/RNDZ SNS
June 26	A/G Remoting Test - GSFC, GDS, MAD
June 26	FRT Tape Playback
June 26 - 27	MCC/MSFN Vals 1041.1, 2044 - GSFC, GYM, GWM, GDS, HSK, MER, CRO, MAD, CYI
June 26 - 27	CMS/LMS DOI/DES SNS
June 27 - 28	MCC/MSFN Vals 1041.1, 2044 - GSFC, HAW, VAN, RED, GBM, ANG, BDA, MIL, TEX, ACN, 2044 - GSFC, MER
June 27	MCC/MSFN Vals 1041.3 - GSFC, GYM, GDS 3044, 3047 - GSFC, RED, HTV, VAN, MER 3046, 3047 - GSFC, ACN, CYI, MAD, MAD-X, GYM, GBM, ANG, GDS, GDS-X, TEX, BDA, CAL, MIL, GWM, HAW, CRO, TAN, HSK, HSK-X
June 27	LMS PD SNS
June 28	Math Model Lunar Surface Sim
June 29	LM EMOD C/O
June 30 - July 2	Wet CDDT
June 30	Network Briefing
June 30	Math Model LOI SNS
July 2	Net Sim
July 3 - 4	ALSEP Vals 1051, 1051.1 - GSFC, GWM, HSK
July 3	ALSEP Vals 1051, 2051 - GSFC, TEX 1051, 2051.1 - GSFC, BDA, GDS, HAW

July 3	End to End Data Flow Test
July 3	Dry CDDT
July 5	LMS PD Abort Sim
July 7 - 8	ALSEP Vals 1051, 2051 - GSFC, ACN, MAD 1051, 2051.1 - GSFC, CRO, CYI
July 7	EASEP Sim
July 7	CMS/LMS ASC/RNDZ/TEI SNS
July 8	EASEP Sim (Day to Night, Night to Day)
July 8	Math Model ASC/RNDZ SNS
July 8	Acquisition Message Transmission
July 8	GMSN TLI Proc. Briefing - GSFC, MER, RED
July 9	CMS Launch Sim
July 9	Paper Sim - GSFC, GDS-X, HSK-X, MAD-X
July 10	EASEP Sim - (Checkout and Configuration of PSE)
July 10	CMS TLI SNS
July 11	Net Sim - EASEP
July 11	Net Sim
July 11 - 12	SESL Tape Play
July 12	Recovery Sim
July 13	Recovery Sim
July 14	Recovery Sim
July 14	EASEP Sim (Night to Day, Day to Night)
July 14	A/G Remoting Test
July 14	ALSEP I/F C/O

July 15	EASEP Sim (Deploy and Start Up)
July 15	Recovery Sim
July 16 - 24	Mission

B. MSFN Site Utilization

Table I represents the total hours that the MCC interfaced with each MSFN site for all Apollo 11 premission support. This includes all simulations, validations and pad test support. Table II shows the number of hours devoted to TLM, CMD or TRK data validation by the MCC with the various sites.

MSFN SITE UTILIZATION ANALYSIS

Site	TABLE I					TABLE II		
	Premission I/F Hours	Prime Time MSC	Prime Time Site	Premium Time MSC	Premium Time Site	TLM	CMD	TKG
ALDS	257.5	144.5	151.0	113.0	106.5	10.0		
ACN	31.0	18.0	13.5	13.0	17 5	5.0	5.0	1.0
ANG	26.0	16.5	18.0	9.5	8.0	1.0	1.0	1.0
BDA	17.0	8.0	9.0	9.0	8.0	3.0	3.0	1.0
CAL	14.5	9.0	8.5	5.5	6.0			1.0
CRO	26.5	16.5	4.0	10.0	22.5	3.0	3.0	1.0
CYI	23.0	13.0	10.5	10.0	12.5	3.0	3.0	1.0
GBM	15.5	8.0	9.0	7.5	6.5	1.0	1.0	1.0
GDS	37.0	21.5	18.5	15.5	18.5	5.0	3.0	1.0
GWM	25.5	17.5	4.0	8.0	21.5	3.0	1.0	1.0
GYM	30.0	18.5	16.5	11.5	13.5	5.0	1.0	1.0
HAW	25.5	18.0	14.0	7.5	11.5	3.0	3.0	1.0
HSK	34.0	18.5	9.0	15.5	25.0	4.5	1.0	1.0
HTV	9.0	4.0	1.0	5.0	8.0			1.0
MIL	165.5	75.5	125.5	90.0	40.0	38.0	25.0	1.0
MAD	36.0	20.5	18.5	15.5	17.5	5.0	5.0	1.0
MER	14.0	5.5	3.0	8.5	11.0	1.0	2.0	1.0
RED	18.0	9.5	6.5	8.5	11.5	1.0	1.0	1.0
TAN	17.5	8.0	8.5	9.5	9.0			1.0
TEX	18.0	11.0	11.0	7.0	7.0	5.0	5.0	1.0
VAN	15.5	8.0	8.5	7.5	7.0	1.0	1.0	1.0

C. Mission Program Build and Testing

The build and testing of the Apollo 11 RTCC program utilized 1778 hours of computer time. The build began in January 1969, and updates were added until the program was delivered in May 1969.

The CCATS program was delivered in April 1969. A total of 291.5 hours were utilized for building and testing of the program. This included 136 hours on the online, 8 hours on the standby and 147.5 hours on the offline computers.

The development and testing of the ALSEP system required 2140 hours. Development began in September 1968, and continued until program delivery in July 1969.

4.2 Network Status

Network Status recording for Apollo 11 began with the ISI #1. Upon being placed in Mission Status, the site status was maintained and displayed via TV to the Mission Operations Control Room. This status was obtained from daily site status messages from Station M&O and from coordination with the Network Support Team at GSFC. Status Messages were received at specific intervals during the support count, with the last being a voice check at T-3 minutes. After launch, status was reported verbally to the Network Controller and by TTY to the Status Monitor. During Apollo 11 (ISI #1 to Splash) the Status Monitor received 884 status messages.

The LOS, AOS and maximum elevation were extracted from the PSA tables and used along with the mission tracking requirements to determine remote site release criteria. A site was released totally or partially dependent upon the following:

A. USB maximum elevation less than 3 degrees.

B. Site not required for 6 hours.

C. MCC tracking requirements

4.2.1 Network Status at launch is listed below. The red can support items indicate that some piece of equipment in the system was down, but that backup units were available or the outage would not cause a major effect on the systems support.

ACN	No "red" items
ANG	No "red" items
BDA	No "red, cannot support" items
CAL	No "red" items
CYI	No "red, cannot support" items
CRO	No "red, cannot support" items
GBM	No "red" items
GDS	No "red" items
GDS-X	No "red" items
GYM	No "red" items
GWM	No "red, cannot support" items
HAW	No "red" items
HSK	No "red" items (except slow scan TV)
HTV	No "red, cannot support" items (except USB ant)
MAD	No "red" items
MER	No "red, cannot support" items
MIL	No "red" items
ETR, PAT	No "red, cannot support" items
RED	No "red, cannot support" items
VAN	No "red, cannot support" items
AOCC	
ARIA 1	"Green"
ARIA 2	"Green"
ARIA 3	"Green"
ARIA 4	"Green"
ARIA 5	"Green"
ARIA 6	"Red, can support" (no TTY)
TAN	No "red" items
TEX	No "red" items

4.2.2 Network Support of Apollo 11 is listed below, the hours shown indicate the interface time between the site and MCC. The times indicated are total support times from T-3 hours in the terminal count until the site was released from mission support.

SITE	HOURS	SITE	HOURS
CNV	3 hrs. 35 min.	GBM	5 hrs. 57 min.
ALDS	12 hrs. 32 min.	HTV	6 hrs. 06 min.
ARIA 1	3 hrs. 28 min.	GTK	5 hrs. 57 min.
ARIA 2	3 hrs. 28 min.	CRO	108 hrs. 07 min.
ARIA 3	6 hrs. 07 min.	MAD	87 hrs. 02 min.
ARIA 4	6 hrs. 03 min.	MAD-X	85 hrs. 56 min.
ARIA 5	6 hrs. 02 min.	HSK	102 hrs. 09 min.
ARIA 6	5 hrs. 57 min.	HSK-X	103 hrs. 11 min.

SITE	HOURS	SITE	HOURS
ARIA 7	5 hrs. 57 min.	CYI	76 hrs. 75 min.
ARIA 8	5 hrs. 58 min.	ACN	92 hrs. 29 min.
PAT	5 hrs. 57 min.	CAL	5 hrs. 57 min.
ASC	5 hrs. 57 min.	AOCC	6 hrs. 07 min.
PRE	5 hrs. 57 min.	ANG	92 hrs. 37 min.
VAN	5 hrs. 57 min.	BDA	89 hrs. 35 min.
TAN	5 hrs. 57 min.	MIL	91 hrs. 05 min.
MER	5 hrs. 57 min.	TEX	88 hrs. 17 min.
RED	5 hrs. 57 min.	GYM	92 hrs. 02 min.
ANT	5 hrs. 57 min.	GDS	96 hrs. 11 min.
MLA	5 hrs. 57 min.	GDS-X	95 hrs. 04 min.
GBI	5 hrs. 57 min.	HAW	99 hrs. 36 min.
GWM	102 hrs. 29 min.		

4.2.3 Utilization of the RTCC and CCATS computers in direct support of the Apollo 11 Mission constituted a total of 427 hours in the RTCC and 395.5 hours on the CCATS. A breakdown of these hours is as follows:

RTCC	HOURS
Flight Control	352
Operations Support	75
	427

CCATS	ONLINE	STANDBY	OFFLINE	TOTAL
Flight Control	197.5	99.5		297
Operations Support	43.5	37.5	17.5	98.5
				395.5

During the Apollo 11 Mission, no major premission testing was conducted for the next mission.

5.0 ALSEP PERFORMANCE (THROUGH CM REENTRY)

5.1 The Early Apollo Scientific Experiment Package (EASEP) deployed on the lunar surface was performing very well at splashdown of Apollo 11. The MSFN support during the period was excellent and only a few problems were experienced.

5.1.1 CRO's support during the deployment and checkout of the EASEP was outstanding. MIL should also be commended for their support and aid in trouble-shooting the hardware problems at CYI and TEX.

5.1.2 CYI and TEX had uplink problems that were isolated to hardware. CYI corrected their problem by accomplishing an updata buffer wiring change. The problem at TEX was cleared by bypassing the cable data multiplexer and switching to a hardline configuration to the USB area.

5.1.3 CYI lost a parametric amplifier seconds before the lunar module ascent phase; thus, no EASEP data was recorded during this phase.

5.1.4 One other problem was experienced at all sites. Command Verification Words (CVW's) were received when there was no uplink executes. These unexpected CVW's did not have any significant impact. Preliminary investigations indicated that these CVW's were downlinked by the EASEP.

5.2 Procedures

Several procedural discrepancies were noted; however, they had no significant impact on network support. A review of the ALSEP procedures will be made by MSC after the lunar night starts.

5.3 The following EASEP anomalies were noted during the Apollo 11 mission:

A. July 21, 1969

Time: 21/0107Z

Problem: The ALSEP Computer Subsystem (ALCS) showed a loss of 90 frame sync and an incorrect vehicle ID (3 vice 2) in TEX telemetry data.

Impact/Resolution: No impact since the problem was corrected during the interface testing. The cause was an illegal vehicle combination entered during TEX's initialization. ISI #105 was issued to identify the correct initialization parameters.

Time: 21/0838Z

Problem: CRO was dropping decom lock.

Impact/Resolution: The impact was a 5 second loss of telemetry data. CRO reported that the problem was due to a bad patch.

Time: 21/0849Z

Problem: ALCS command history printout indicated that invalid command verification words (CVW's) were downlinked following a valid CVW, and two CVW's were downlined when no commands were uplinked.

Impact/Resolution: No impact since no other abnormal indications were noted. The invalid CVW's were similar to what was experienced during the Qual Model Test, which had been isolated (suspected) to a decoder gate problem. This problem will require further investigation.

Time: 21/0927Z

Problem: The ALCS (360/50) experienced a master check/hard stop.

Impact/Resolution: The impact was an approximate 39 minute loss of telemetry data. A 360/75 computer was brought online and the 360/50 was turned over to maintenance personnel. A PC card was changed and the 360/50 was brought back online at 1117Z.

Time: 21/1334Z

Problem: CYI System 1 power amplifier (PA) was reported "red" due to overheating.

Impact/Resolution: No impact as problem was overcome by bypassing the thermal control relay; however, the PA was turned on only when a command sequence was required.

Time: 21/1432Z

Problem: CYI received spacecraft rejects on all ALSEP commands.

Impact/Resolution: The impact was a loss of command capability. CRO was reconfigured for ALSEP support until CRO LOS. Subsequent trouble-shooting with CYI resulted in a 75 percent success rate capability on ALSEP commands. CYI isolated the problem on July 23, 1969, and reported that the problem corrected by an updata buffer wiring change (reference CYI TWX 24/0140Z).

Time: 21/1748Z

Problem: CYI parametric amplifier went "red" approximately 90 seconds prior to the lunar module ascent.

Impact/Resolution: The impact was the loss of all EASEP telemetry data during the ascent phase. CYI substituted the acquisition parametric amplifier and was "green" at 1810Z.

Time: 21/1815Z

Problem: TEX received spacecraft rejects for all EASEP uplink attempts.

Impact/Resolution: All command capability was lost through TEX. CYI was retained for EASEP support with a marginal command capability. The problem was cleared at 22/1813Z by bypassing the cable data multiplexer (CDM) and switching to a hardline configuration to the USB areas. The CDM equipment was causing a 180 degree phase inverstion of the 1-2 kc composite signal.

B. July 23, 1969

Time: 23/1148Z

Problem: CRO high speed data not arriving at MCC.

Impact/Resolution: The impact was a 2 minute loss of telemetry data. The CRO CLT was inadvertently taken off line. The CLT was placed back on line and the data was restored.

C. July 24, 1969

Time: 24/1530Z

Problem: Data not arriving at MCC.

Impact/Resolution: The impact was a 16 minute loss of telemetry and command interface with ACN; telemetry data was recorded on site. GSFC had removed ACN from the Atlantic satellite to provide circuits for TV transmission of Apollo 11 recovery operations to South America. The alternate circuits were bad and had to be made good.

5.4 EASEP RTCC Execute Table

The Table in this section shows all the RTC's executed from EASEP deployment through Apollo 11 splashdown. There were no ground rejects (GND REJ); this was due to the absence of site ground loop problems and excellent MCC/MSFN coordination before RTC's were executed. The four spacecraft rejects (S/C REJ) at MIL and CRO were the result of changing EASEP transmitters and were functionally verified. The S/C REJ's at CYI and TEX were due to hardware problems (reference paragraph 5.1.2).

EASEP RTC EXECUTE LOG

Deployment to Apollo 11 Splash

7-21-04-40-49 to 7-24-16-50-00

SITE	I/F	RTC'S	VERS	S/C REJ	GND REJ	TOTAL
MIL	9	48	44	4	0	57
BDA	0	0	0	0	0	0
ACN	3	4	4	0	0	7
CYI	3	100	30	70	0	103
MAD	0	0	0	0	0	0
CRO	10	154	150	4	0	164
HSK	6	26	26	0	0	32
GWM	0	0	0	0	0	0
HAW	0	0	0	0	0	0
GDS	3	3	3	0	0	6
TEX	9	121	99	22	0	130
TOTAL	43	456	356	100	0	499

AC	Alternating current
ACN	Ascension Island MSFN station
Acq Aid	Acquisition Aid
AFC	Automatic Frequency Control
AFETR	Air Force Eastern Test Range
AFWTR	Air Force Western Test Range
A/G	Air-to-Ground
AGAVE	Automatic Gimbaled Antenna Vector Equipment
AGC	Automatic Gain Control
AIS	Apollo Instrumentation Ship
ALSEP	Apollo Lunar Surface Experiment Package
AM	Amplitude Modulation
ANG	Antigua Island MSFN station
AOCC	Aircraft Operations Control Center
AOS	Acquisition of Signal
APB	American Projects Branch of the Australian DOS
APP	Antenna Position Programmer
APS	Ascent Propulsion System
ARIA	Apollo Range Instrumentation Aircraft
ATS	Applications Technolgy Satellite
AZ	Azimuth
BCD	Binary Coded Decimal
BDA	Bermuda MSFN station
BER	Bit Error Rate
Biomed	Biological-medical
CADCPS	Combined Antenna Drive Command Program System
CADFISS	Computation and Data Flow Integrated Subsystem
CAL	South Vandenberg, California C-band station
CAM	Computer Address Matrix
CAP	Command Analysis Pattern, also Command Acceptance Pulse
CapCom	Capsule communicator
CAPRI	Compact All-Purpose Range Instrument
C-band	3900 to 6200 MHz
CBARF	Command Backup Automatic Recovery Feature
CCATS	Command Communication and Telemetry System
CCS	Command Control System
CDP	Central Data Processor
CDR	Commander

CDDT	Countdown Demonstration Test (Prelaunch)
CF	Center Frequency
CM	Command Module
CMD	Command
CMP	Command Module Pilot
ComTech	Communications Technician
CP	Communications Processor
CRF	Capsule Radiation Frequency
CRO	Carnarvon, Australia MSFN station
CRR	Change Recommendation Report
CSC	Contingency Sample Collection
CSM	Command Service Module
CW	Continuous Wave
CYI	Canary Island MSFN Station
DAC	Digital-To-Analog Converter
Db	Decibel
dBm	Decibel referred to 1 milliwatt
dc	Direct current
DCI	Documentation Change Instruction
DCN	Documentation Change Notice
DDF	Digital Data Formatter
DDMS	Department of Defense Manned Flight Support Office
Decom	Decommutator
Demod	Demodulator
DOD	Department of Defense
DOI	Descent Orbit Insertion
DOS	Australian Department of Supply
DPS	Descent Propulsion System
DSDU	Decommutation System Distribution Unit
DSE	Data Storage Equipment
DSIF	Deep Space Instrumentation Facility
DSN	Deep Space Network
DSS	Data Services Section
DSS-71	Deep Space Station-71 (JPL, Merritt Island)
DTU	Data Transmission Unit
EASEP	Early Apollo Surface Experiment Package
EI	Engineering Instruction
EKG	Electrocardiogram
EL	Elevation

EMOD	Erasable Memory Octal Dump
EMU	Expanded Memory Unit
EO	Earth Orbit
EOF	End Of File
EOI	Earth Orbit Insertion
ETA	Estimated Time of Arrival
ETO	Estimated Time of Operation
EVA	Extra Vehicular Activity
FLTLD	Fault Load Tape (Automatic Recovery Program)
FM	Frequency Modulation
FPS	Feet Per Second
FSR	Flight support request
GBM	Grand Bahama Island MSFN Station
GCC	Ground Communication Coordinator
GDS	Goldstone, California MSFN Prime Station
GDSX	Goldstone, California Wing Station
GET	Ground Elapsed Time
GMT	Greenwich Mean Time
GOSS	Ground Operations Support System
GRTC	Goddard Real-Time Computer
GRTS	Goddard Real-Time System
GSFC	Goddard Space Flight Center, Greenbelt, Maryland
GWM	Guam, Marianas Island MSFN Station
GYM	Guaymas, Mexico MSFN Station
HAW	Kokee Park, Kauai Island, Hawaii MSFN Station
HBR	High Bit Rate
HBRD	High Bit Rate Dump
HF	High Frequency (3 To 30 MHz)
HGA	High-Gain Antenna
HS	High Speed
HSD	High-Speed Data
HSK	Honeysuckle Creek, Australia MSFN Prime Station
HSKX	Honeysuckle Creek, Australia Wing Station
HSP	High-Speed Printer
HTV	USNS Hunstville
Hz	Hertz (Cycle/Sec)
IC	Instrumentation Coordinator
IDRAN	Integrated Digital Range
IF	Intermediate Frequency

I/O	Input/Output
IRIG	Interrange Instrumentation Group (Telemetry Frequency)
IRV	Interrange Vector
ISA	Interface Systems Adapter
ISI	Instrumentation Support Instruction
IST	Integrated System Test
IU	Instrumentation Unit
JPL	Jet Propulsion Laboratory, Pasadena, Calif.
Kbps	Kilobits Per Second
Kbs	Kilobits
KHz	Kilohertz
KSC	Kennedy Space Center, Cape Kennedy, Florida
LBR	Low Bit Rate
Lbs	Pounds
LDN	London
LES	Launch Escape System
LM	Lunar Module
LMP	Lunar Module Pilot
LO	Lunar Orbit
LOI	Lunar Orbit Insertion
Loran	Long-Range Navigation
LOS	Loss of Signal
LS	Low Speed
LSB	Least Significant Bit
LSD	Low-Speed Data
LSR	Launch Support Request
LTDS	Launch Trajectory Data System
LV	Launch Vehicle
LVDC	Launch Vehicle Digital Computer
ma	Milliampere
MAD	Madrid, Spain MSFN Prime Station
MADX	Madrid, Spain Wing Station
MAP	Message Acceptance Pulse B-5
MARS	Goldstone DSN 210-Foot Antenna
MCC	Mission Control Center Houston, Texas
MER	USNS Mercury
MFED	Manned Flight Engineering Division
MFOD	Manned Flight Operations Division
MFPAD	Manned Flight Planning and Analysis Division

MHz	Megahertz
MIL	Merritt Island, Florida MSFN station
mm	Millimeter
MMR	M&O Postmission Report
M&O	Maintenance and Operations
MOCR	Mission Operations Control Room
Modem	Modulator/Demodulator
MOM	Maintenance Operations Manual
MSC	Manned Spacecraft Center, Houston, Texas
MSFC	Marshall Space Flight Center, Huntsville, Ala.
MSFN	Manned Space Flight Network
MSFNOC	Manned Space Flight Network Operations Center
MSFTP	Manned space flight telemetry processor
MTU	Magnetic Tape Unit
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications Network
NC	Network Controller
NCG	Network Control Group
ND	Network Director
nmi	Nautical mile
NOD	Network Operations Directive
NOM	Network Operations Manager
NRT	Network Readiness Test
NST	Network Support Team
NTTF	Network Test and Training Facility at GSFC
ODOP	Offset Doppler Velocity and Position
omni	Omni-directional antenna
OMSF	Office of Manned Space Flight
OPN	Operations message
OUCH	Offline Universal Command History 642B program
PA	Power Amplifier
PAM	Pulse Amplitude Modulation
PAOS	Predicted Acquisition of Signal
Paramp	Parametric Amplifier
PBI	Push Button Indicator
PBR	Premission Briefing Report
PCA	Point of Closest Approach
PC Card	Printed Circuit Card
PCM	Pulse Code Modulation

PDI	Powered Descent Initiation
PFS	Precision Frequency Source
PLIM	Post Launch Instrumentation Message
PLSS	Portable Life Support System
PM	Phase Modulation
PMR	Postmission Report
Preamp	Preamplifier
PRN	Pseudo Random Noise
PSK	Phase-Shift Keyed
psi	Pounds per square inch
PSRD	Program Support Requirements Document
PTC	Passive Thermal Control
RCS	Reaction Control System
R/E	Receiver/Exciter
RED	USNS Redstone
RF	Radio Frequency
RFI	Radio Frequency Interference
RIC	Request for Instrumentation Clarification
RSCC	Remote Station Command Computer
RSDP	Remote Site Data Processor
RSO	Range Safety Officer
RTC	Real-Time Command
RTCC	Real-Time Computer Complex
RTCS	Real-Time Computer System
SATCOM	Satellite Communications
S-band	1500 to 3900 Mile
S/C	Spacecraft
SCAMA	Switching, Conference, And Monitoring Arrangement
SCM	Site Configuration Message
SCO	Subcarrier Oscillator
SD	Standard Deviation
SDDS	Signal Data Demodulator System
S-IC	Saturn V First Stage
S-II	Saturn V Second Stage
S-IVB	Saturn V Third Stage
SLA	Spacecraft Lunar Adapter
SM	Service Module
S/N	Signal/Noise
SPAN	Solar Particle Alert Network

SPE	Static Phase Error
SPS	Service Propulsion System
SRT	Station Readiness Test
SST	Subsystem Test
ST	System Test
STADAN	Space Tracking and Data Acquisition Network
TAN	Tananarive, Malagasy Republic, STADAN station
TDP	Tracking Data Processor
TEC	Trans Earth Coast
TEI	Trans Earth Injection
TELTRAC	Telemetry Tracking (Canoga Acq Aid System)
TETR-B	Test and Training Satellite-B
TEX	Corpus Christi, Texas MSFN Station
TIC	Telemetry Instrumentation Coordinator
TLC	Translunar Coast
TLI	Translunar Injection
TLM	Telemetry
TSI	Test Support Instruction
TSP	Test Support Position
TTY	Teletype
TV	Television
TWX	Teletype Wire Exchange Message
UDB	Up Data Buffer
UHF	Ultra-High Frequency
USB	Unified S-Band
VAN	USNS Vanguard
VCO	Voltage Controlled Oscillator
VHF	Very-High Frequency
VOGAA	Voice-Operated Gain Adjusting Amplifier
VR	Voltage Regulator
VSWR	Voltage Standing Wave Ratio