Determining Availability Characteristics of DSN Data Systems Using Discrepancy Report Data

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A reasonably economical way has been developed to determine availability characteristics of DSN data systems, subsystems, and assemblies using the DSN Discrepancy Report (DR) database and DSN operating schedule and history databases. Operating Mean Time Between Failures (OMTBF), Operating Mean Time to Restore Service (OMTTRS), and Operating Functional Availability (OFA) can be computed by year, by system, by subsystem, by assembly, and by station.

In this report, the effort required to produce the desired reports is described; specific data on the Telemetry, Command, and Tracking Systems are presented; and major contributors to system outages are identified. Future improvements in preparing and analyzing DR data are also outlined to enhance their use in correcting conditions that lead to outages.

I. Introduction

The purpose of this investigation is to develop an economical way to determine the Operating Mean Time Between Failures (OMTBF), Operating Mean Time To Restore Service (OMTTRS), and Operating Functional Availability (OFA) of DSN data systems, subsystems, and assemblies using an existing Discrepancy Report (DR) database. The DR database contains records of DSN outages that occur during scheduled service. It is an attractive source because it is mandated by JPL policy[1] and is necessarily maintained even when budgets are oversubscribed. The availability characteristics (OMTBF, OMTTRS, and OFA) of DSN data systems and their major elements can be used to determine which aspects of the DSN are causing service downtime. The latter information can of course be used in prioritizing DSN maintenance and redesign activities.

This investigation is based on Discrepancy Reports (DR) for the DSN Telemetry (TLM) System, Command (CMD) System, and Tracking (TRK) System, and their respective subsystems and assemblies for the period January 1981 through September 1984. While DRs were prepared long before 1981, it has been only since that time that they have been stored in a machine-readable form. Data are available by day, by week, and by year and by DSN station.

An outage of a DSN system other than the Telemetry, Command, and Tracking Systems does not necessarily cause a

[1] JPL Standard Practice Instruction 4-11-5, *Problem/Failure Accountability*, September 17, 1984, 4 pages (internal document), and Document 841-1, *DSN Standard Operations Plan*, Section 9, May 24, 1982, 11 pages (internal document).

DR to be written if it does not cause an outage in one of these three key data systems. Also, DRs are not necessarily written even for outages in a key system if the data are recovered by auxilliary means, e.g., via playback of a tape recorder.

Discrepancy Reports are written only when a station is scheduled to provide certain types of service, namely spacecraft tracking, project-related support, project preparation, and multimission support. DRs are not written during periods of maintenance, implementation, and other non-service periods. Accordingly, the parameters presented below are based only on so-called operating hours and are therefore labeled Operating Mean Time Between Failures (OMTBF), Operating Mean Time to Restore Service (OMTTRS), or Operating Functional Availability (OFA).

As described in Section II.A, the calculation of availability characteristics requires knowledge of the hours of operation scheduled for each system. Unfortunately, the operating data now available lack detail about when some functions were actually used or were scheduled for use. This latter phenomenon severely limits analyses of both Command System and Tracking System parameters. It does not significantly affect the Telemetry System, which is almost always "on" whenever a station is scheduled to provide service. As a consequence, availability characteristics can be readily calculated for the Telemetry System, but similar calculations for the Command and Tracking Systems cannot be performed using the historical data.[2]

Also, when parallel assemblies exist, i.e., a prime with backups, the DR database does not distinguish among the alternative assemblies. Nor does the DR database necessarily include information on whether a backup assembly was available when a prime assembly failed or whether service was restored by using a backup or by recovery of the prime unit.

II. Approach

A. General Description

A Discrepancy Report (DR) is prepared whenever the DSN fails to serve a customer as planned. Each DR identifies the system, subsystem, assembly, and station that caused the failure, the time that the outage occurred and its duration, and a description of the failure. These reports are entered into a computer database called the DR database. The DR database can thus be sorted to provide summaries of outages for various data systems, for their respective subsystems and assemblies, and for individual stations, all for various periods of time.

Separately, the DSN records the history of its operations by station. These records show the number of operating hours by week, but they do not show which functions are performed while operating. However, it is commonly believed that a station's Telemetry System is "on" nearly 100% of the time that the station operates. The Command and Tracking Systems are generally operated only fractions of the time that a station is "on," but the fractions cannot be determined without manually searching a multitude of project logs and then inferring how long the equipment was "on."

The Operating Mean Time Between Failure (OMTBF) for a particular system, subsystem, assembly, or station can be calculated by dividing the number of operating hours in a given period by the corresponding number of outages.[3] Likewise, the Operating Mean Time to Restore Service (OMTTRS) for a system, subsystem, assembly, or station can be calculated by dividing the total duration of outage in a given period by the corresponding number of outages.

Operating Functional Availability (OFA) is the fraction of the time that a system, subsystem, assembly, or other element functions according to plan. It can be calculated by dividing the average "on" time (or "up" time) by the sum of the average "on" time and the average "down" time. The average "on" time is OMTBF and the average "down" time is OMTTRS, so OFA is given by the following formula:

$$OFA = (OMTBF)/(OMTBF + OMTTRS)$$

In the following sections are descriptions of the data sources and their use and of the processes used to reduce the data.

B. Data Sources

The Discrepancy Report (DR) database is a computerized database compiled from information gathered on the form shown in Fig. 1. This form was designed originally to describe individual outages and not particularly to facilitate statistical studies. Accordingly, much information is in narrative form, with little or no control of vocabulary or level of detail. Only

[2] Project logs contain operating history data that are needed to calculate availability characteristics for the Command and Tracking Systems. However, these logs are generally scattered manual records that cannot be readily searched for relevant data. Moreover, some inference is required to determine how long the Command or Tracking Systems were actually "on" for the events noted in these logs.

[3] More precisely, an OMTBF can be calculated by dividing the number of outages into scheduled operating time less outage time. However, when outage times are small compared with scheduled operating times, as is the case here, then the differences in the two calculational approaches are insignificant.

synopses of narratives are recorded in the DR database unless, of course, they are so brief that they can be recorded in their entirety.

The DR database is a hierarchically organized computer-based file. The Telemetry, Command, and Tracking Systems' data are thus in separate, unrelated records. Data on subsystems that are part of more than one system, e.g., the Antenna Mechanical Subsystem, are repeatedly filed under each system of which they are part.

Station operating hours (SOH) and end user hours (EUH) are summarized weekly in hard-copy DSN Station Utilization Summary Reports. An example of a Station Utilization Summary Report is given in Fig. 2. The raw data for the utilization reports for the current year are readily available, but tapes for prior years are now kept only in archive files. Station Utilization Summary Reports are organized by station, by project, and by support category. "Support category" includes spacecraft tracking (category 1A1), project-related support (category 1A2), project preparation (category 1A3), multimission support (1A4), preventive maintenance (category 2A1), corrective maintenance (category 2A2), and so forth. Finer levels of detail of these categories have not been recorded.

Several qualifying comments about the data are warranted. First, the fact that DRs are written only when a DSN customer is being supported eliminates all categories other than 1Ax from further consideration in this study. Also, DRs are not written during system integration tests, which are part of category 1A3, and tests of automatic gain controls, which are part of category 1A4. However, each of these activities amounts to less than one percent of its respective category, which is itself only a few percent of the total time for category 1Ax. Thus, the inclusion of system integration tests and tests of automatic gain controls hardly affects the overall results reported below.

DRs are not necessarily written for outages that occur during pre-pass and post-pass calibrations. If an outage affects DSN service to a customer or would have done so if it were not for heroic efforts, then a DR is written. Otherwise, a DR might not be written. The extent of the impact of this uneven practice on the data is not clear, but the direction of the impact is clear: It causes calculated OMTBSs and OFAs to be somewhat more attractive than they really are.

Second, DR data are subject to being "corrected" as detailed DR investigations continue. Also, minor adjustments are sometimes made to SOH data after initial SOH summaries are prepared. Accordingly, this investigation has used the latest data available, which may produce small differences from any results obtained using earlier data. Our tests of such instances indicate that these differences are insignificant in the context of this study.

Third, a class of DRs exists, known as master DRs, which are not considered in this study. A "master DR" is a DR file used to collect information from individual DRs all of which seem to be related to a common situation. Since a master DR duplicates information already contained in "regular" DRs, it is inappropriate to include them in this investigation.

Fourth, instances of misspelling of DSN subsystems and assemblies have been discovered in the DR database when listing outages by subsystem or assembly. In most cases, misspelled elements can be properly identified, and indeed this study consolidates apparently different categories when it is appropriate to do so. In a few cases, however, a misspelled element remains a mystery, and the outage escapes being correctly listed as part of a given class. In addition, some DRs show no subsystem or assembly for the outage; these too escape listings by these parameters.

And finally, data are reported weekly but longer periods such as a month, a quarter, or a year are often more convenient in analyzing trends. Because none of these is composed of even multiples of a week, the following convention is used by the DSN. A year is generally divided into four quarters of thirteen weeks, and each quarter is then divided into three periods of four, four, and five weeks, respectively. Of course, no year is exactly fifty-two weeks, and every few years a fifty-three week year, i.e., a leap year, is required. When this occurs, the extra week is added to the first period of the fourth quarter. This leap quarter then has three periods of five, four, and five weeks, respectively. The year 1981 was a fifty-three week year, and 1982, 1983, and 1984 were fifty-two week years.

C. Data Processing

Three approaches to data processing were considered. The first is to perform all calculations in the JPL IBM 3083 computer, on which the DR database is installed. In this approach, operating history data would be added to the IBM 3083 computer and the DR database would be queried directly for the information needed for each calculation. This approach was rejected in favor of another because it is difficult to access the DR database on demand.

The second approach is to derive files of DRs from the DR database which would be kept in the Univac 1100/81 system and used there together with operating history data, which it already contains. This approach would obviate the need to access the original DR database on demand, but it still involves depending upon third parties and their facilities to do interactive processing.

Both of the approaches described above were rejected in favor of a third approach. This latter approach uses a personal computer to maintain both DR files extracted from the DR database and operating history data. The same personal computer is then used to process the data. This approach simplifies both administrative and operational considerations and allows ready access to the data for analyses.

The actual calculations for processing the data are as described in Section II.A. The only additional information required to produce the desired reports is the set of parameters by which some DRs are selected and others are not, e.g., station, system, subsystem, assembly, period of interest, and so forth. These factors are readily used to sort the database in order to prepare specific analyses.

III. Findings

The findings of this investigation are of two types: (1) findings concerning methods, and (2) findings concerning outage and availability characteristics (OMTBF, OMTTRS, and OFA) of DSN data systems. Both are discussed in this section.

A. Methodological Findings

Four methodological findings have been made. First, files can be extracted from the existing Discrepancy Report (DR) database with about 10 minutes of an analyst's time. They are normally received in hardcopy form within 24 hours of the extraction. Data from existing DSN Station Utilization Summary Reports can be entered in about 30 minutes for a one-week reporting period covering up to nine stations. (Note, however, that these reports lack detail about the use of the Command and Tracking Systems. If the latter were included, the time required to enter utilization data could double.)

Second, once all the data files of interest are obtained, a report that lists each outage, its duration, and the station, system, subsystem, and assembly involved can presently be prepared with about two to three hours of an analyst's time, which includes manual data entry from the hard copies into a computer file. Outages can also be listed by station, by system, by subsystem, or by assembly as well as by period.

Third, once outages have been selected, as in the previous paragraph, availability characteristics such as OMTBF, OMTTRS, and OFA can be calculated within one to two hours of elapsed time, with an operator at hand.

Fourth, plots of the data described in the two preceding paragraphs can be readily made in about 15 minutes of elapsed time per plot, with an operator at hand.

B. Data System Findings

Data system findings are presented in two parts. The first part concerns information on data system outages *per se.* The second part concerns Operating Mean Time Between Failures (OMTBF), Operating Mean Time to Restore Service (OMTTRS), and Operating Functional Availability (OFA) information.

1. **Data system outages.** Table 1 shows the number of outages, outage time, and "on" time for the Telemetry System and the number of outages and outage time for the Command and Tracking Systems for 1981, 1982, 1983, and the first nine periods of 1984. "On" time is not available for the latter two systems (see Section II.A).

Both the number of Telemetry System outages and outage time decreased over the period studied. The main reason for these decreases is that the total "on" time also decreased during this period as the number of active stations decreased.[4]

Tables 2, 3, and 4 break down the data in Table 1 by subsystem for the Telemetry, Command, and Tracking Systems, respectively. Breakdowns of the data in Table 1 by facility as well as by subsystem were also prepared and are available from the authors upon request.

2. **Data system availability characteristics.** Table 5 presents OMTBF, OMTTRS, and OFA data for the DSN Telemetry System by subsystem for the period 1981 through period 9 of 1984. Similar calculations cannot be made for the Command and Tracking Systems because of a lack of "on" time information for these systems (see Section II.A). Likewise, similar calculations cannot be made for individual assemblies within the Telemetry System.

The data presented in Tables 1 through 5 lead to the following conclusions:

(1) The Telemetry System had its lowest Operating Functional Availability (OFA) in 1984, whether radio frequency interference (RFI) is included or excluded in the calculation; it was 98.5% when RFI is included and 98.8% when RFI is excluded. The Telemetry System OFA was highest in 1981, when it was 99.1% whether RFI is included or excluded in the calculation (to three-place precision). (Table 5)

(2) The three subsystems within the Telemetry System that accumulated the greatest outage times were the

[4]The number of stations operating from 1981 through September 30, 1984, is as follows: nine stations in 1981, six stations in 1982 and the first half of 1983, and five stations in the last half of 1983 through September 30, 1984.

Antenna (ANT), Microwave (UWV), and Receiver (RCV) Subsystems. Together they accounted for just over 51% of all outage time of the Telemetry System. (Table 2)

(3) The three subsystems within the Telemetry System that were most prone to failure were the Antenna (ANT), Receiver (RCV), and Telemetry (DTM) Subsystems. Together they accounted for just over 40% of all failures of the Telemetry System. (Table 2)

(4) The three subsystems within the Telemetry System that had the longest average restoration times were the Frequency and Timing (FTS), Microwave (UWV), and Transmitter (TXR) Subsystems. Taken as a whole, their average restoration time was 1.67 hours. (Table 2)

(5) The three subsystems within the Command System that accumulated the greatest outage times were the Antenna (ANT), Command (DCD), and Transmitter (TXR) Subsystems. Together they accounted for over 59% of all outage time of the Command System. (Table 3)

(6) The three subsystems within the Command System that were most prone to failure were the Antenna (ANT), Command (DCD), and Transmitter (TXR) Subsystems. Together they accounted for just over 49% of all failures of the Command System. (Table 3)

(7) The four subsystems within the Command System that had the longest average restoration times were the Antenna (ANT), Frequency and Timing (FTS), Microwave (UWV), and Transmitter (TXR) Subsystems. Taken as a whole, their average restoration time was 1.93 hours. (Table 3)

(8) The three subsystems within the Tracking System that accumulated the greatest outage times were the Antenna (ANT), Facilities (FAC), and Tracking (DTK) Subsystems. Together they accounted for just over 51% of all outage time of the Tracking System. (Table 4)

(9) The three subsystems within the Tracking System that were most prone to failure were the Antenna (ANT), Tracking (DTK), and Receiver (RCV) Subsystems. Together they accounted for just over 49% of all failures of the Tracking System. (Table 4)

(10) The three subsystems within the Tracking System that had the longest average restoration times were the Facilities (FAC), Microwave (UWV), and Tracking (DTK) Subsystems. Taken as a whole, their average restoration time was 2.43 hours. (Table 4)

IV. Conclusions and Observations

The DSN Discrepancy Report database and DSN Station Utilization Summary Reports can indeed be used to calculate Operating Mean Time Between Failures (OMTBF), Operating Mean Time to Restore Service (OMTTRS), and Operating Functional Availability (OFA) for the DSN Telemetry System and for various combinations of Telemetry subsystems and DSN stations or facilities. Similar calculations could be made for the Command and Tracking Systems if the Station Utilization Summary Reports also contained "on" time information for these systems.

The amount of time involved on the part of an analyst to extract relevant data and to perform the desired calculations is not insignificant. Much time is now spent in manually reentering data that were already in machine form in the databases. Moreover, analysts require special training in order to extract files of interest.

Outage and availability information on specific assemblies cannot be determined from existing information. However, if the Network Support Subsystem gathers "on" time information by assembly, which ought to be possible once the Mark IVA Monitor and Control System is fully implemented, then assembly-level outage and availability data can be obtained.

Presently, Discrepancy Reports are prepared only for DSN systems that specifically deliver data to DSN customers. Other DSN systems are not included in Discrepancy Reports unless they affect these so-called data systems. Again, however, the Mark IVA Network Support Subsystem can be designed to provide outage and availability information on these network elements, too.

The Discrepancy Report (DR) database could yield greater insight into system and subsystem failures if information now available only in narrative form could be readily searched and sorted. If specific categories of failure were coded, DRs could be sorted accordingly. Also, a menu-driven selection of system and subsystem designators (or a spelling checker) would minimize the number of misspelled entries, which precludes proper classification of some DRs.

Additionally, it is noted that the threshold for initiating a DR depends partly on the precision of the predicts for the application. This of course makes sense, since an application with loose tolerances can accommodate sloppier performance than one with tight tolerances. Yet the DSN's performance *per se* might be the same in two different cases, one with fairly precise predicts and the other with relatively imprecise predicts. When the predicts are fairly precise, a DR would be initiated; when they are imprecise, no DR would be initiated. Thus, the number and duration of outages that are registered in a given period are partly a function of customer predicts, i.e., of the customers themselves, and are not purely measures of DSN performance. It might be worthwhile in the future to stratify DR data by customer or tolerance before analyzing them in order to identify any tolerance-dependent effects.

Finally, it is noted that a significant number of outages are not recognized in real time but are initiated in post-pass analysis by a network operations analyst (NOA). This procedure suffices for discrepancies that can be recognized by NOAs, but it is not comprehensive. In particular, discrepancies that involve two-station operations, e.g., very long baseline interferometry (VLBI), are not necessarily apparent to NOAs but appear only when data from both stations are correlated together by the "project team." It appears that such discrepancies are often not entered into the DR database. To this extent, the DR database understates the number and duration of outages and overstates OMTBFs and OFAs.

V. Future Improvements

Improvements to enhance the use of Discrepancy Reports in determining Deep Space Network (DSN) availability characteristics are being considered in three areas: (1) preparing Discrepancy Reports (DR) and Station Utilization Summary Reports, (2) analyzing outages and availability characteristics of DSN systems, subsystems, and assemblies, and (3) correcting conditions that lead to outages.

(1) Preparing Discrepancy Reports and Station Utilization Summary Reports

(a) Use of a CRT forms-mode input for Discrepancy Reports (DR): A comprehensive input form of this type can provide a controlled and appropriately detailed vocabulary for characterizing outages and their causes, thus facilitating later analyses. Moreover, it can facilitate revising input forms as configurations change in the DSN and as new insight is gained into failure modes and causes. It might also reduce the amount of time needed to log and enter DR inputs.

(b) Automatic compilation of reports of station use, now termed Station Utilization Summary Reports, either from information in the Monitor and Control System or from information entered by station operators using a CRT forms-mode input: This approach can facilitate identifying not only the use of each station (or link, in Mark IV parlance) but also the equipment engaged for each user (see [1] [c] below).

(c) Logging of equipment usage (and perhaps also software usage) from information available in the Monitor and Control System or Network Support Subsystem: This information can be used to compute Operating Mean Time Between Failures (OMTBF), Operating Mean Time to Restore Service (OMTTRS), and Operating Functional Availability (OFA) providing the log also shows the function being performed (see [1] [b] above).

If outages are also recorded when a link is used for maintenance and other non-support activities, then "true" Mean Time Between Failures (MBTF), Mean Time to Restore Service (MTTRS), and Functional Availability (FA) can be determined.

(d) Storage of DR data, equipment usage data, and software usage data in a common machine: This improvement will facilitate outage and availability analyses (see [2] below). (Alternatively, if, for good reasons, the data are maintained in different machines, the data can be organized in ways that facilitate file transfer, combination, and manipulation for the requisite analyses in a single machine.)

(2) Preparing Outage Reports and Availability Analyses

(a) Routine preparation of outage reports and availability analyses, perhaps monthly, for the previous three-, six-, and twelve-month periods.

(b) Use of outage reports to rank culprit systems and subsystems according to frequency and duration of outage and by unavailability for service. Assemblies can also be ranked by unavailability for service if equipment usage is appropriately logged (see [1] [c] above).

(3) Correcting Conditions That Lead to Outages

Routine distribution of outage reports and availability analyses (see [2] [b]) to DSN system engineers to use in assessing system, subsystem, and assembly performance and taking appropriate corrective action.

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Table 1. Telemetry, Command, and Tracking System outages, by year

System	1981			1982			1983			1984[a]		
	No. of Outages	Outage, Minutes	"On" Time, Hours	No. of Outages	Outage, Minutes	"On" Time, Hours	No. of Outages	Outage, Minutes	"On" Time, Hours	No. of Outages	Outage, Minutes	"On" Time, Hours
Telemetry	516	25,198	47,932	482	23,038	31,882	528	24,365	29,190	409	17,459	22,790
Command	355	23,224	–	216	16,815	–	136	11,155	–	197	15,608	–
Tracking	463	39,426	–	364	23,911	–	289	23,291	–	280	29,102	–

[a]Up to and including September 30, 1984

Table 2. Telemetry System outages by subsystem and by year

Year	1981		1982		1983		1984[a]	
S/S	No.	Min.	No.	Min.	No.	Min.	No.	Min.
AES	0	0	0	0	0	0	0	0
ANT	108	5892	120	5340	77	5094	47	2970
APS	32	657	23	605	15	258	31	910
DCD	0	0	2	95	1	1	0	0
DMC	4	112	4	353	3	110	3	84
DRG	0	0	0	0	1	3	0	0
DRS	1	8	0	0	2	131	1	10
DTK	4	80	6	173	7	164	4	68
DTM	68	2876	53	2892	47	636	65	3718
DTS	0	0	0	0	0	0	1	360
EXT[b]	2	70	0	0	0	0	0	0
FAC	32	1210	22	1112	18	875	16	589
FTS	4	168	8	661	4	406	5	449
GHS	32	964	6	67	7	45	11	409
GPS	1	1	0	0	0	0	0	0
GVC	1	23	4	212	2	23	0	0
GWB	5	50	2	8	1	17	2	70
NCD	0	0	0	0	0	0	1	15
NCE	5	73	5	46	0	0	0	0
NDS	3	44	3	47	1	43	0	0
NMC	2	22	1	22	0	0	0	0
NSS	0	0	0	0	1	21	0	0
NTK	1	2	0	0	1	45	1	5
NTM	4	42	0	0	1	158	2	17
OSA[b]	0	0	1	23	0	0	0	0
OSG[b]	0	0	2	33	1	2	9	78
PDX	7	139	8	157	6	807	5	73
RCV	80	4561	61	3533	68	3431	50	2950
RFI	16	434	55	2282	196	6706	114	3515
TXR	15	1422	9	290	12	667	20	1220
UWV	40	4817	25	3658	36	4246	12	1021
UNK[c]	49	1531	63	1435	20	476	49	1716
Total	516	25198	483	23044	528	24365	449	20247
Hours		419.966		384.066		406.083		337.45

[a]Up to and including period 9 (September 30, 1984)
[b]Not a standard DSN abbreviation
[c]UNK: Unknown

Table 3. Command System outages by subsystem and by year

Year	1981		1982		1983		1984[a]	
S/S	No.	Min.	No.	Min.	No.	Min.	No.	Min.
AES			0	0	0	0	2	213
ANT	63	5381	55	6034	32	2611	17	1607
APS	11	343	6	173	2	69	9	628
DCD	63	1496	20	869	23	907	44	4041
DMC	1	590	0	0	0	0	2	235
DRG	0	0	0	0	0	0	0	0
DRS	0	0	0	0	0	0	0	0
DTK	10	405	0	0	3	47	2	67
DTM	0	0	0	0	0	0	0	0
DTS	0	0	0	0	0	0	0	0
EXT[b]	0	0	0	0	0	0	0	0
FAC	27	1361	10	901	13	899	10	698
FTS	5	395	11	999	2	210	6	614
GHS	24	570	25	376	2	17	10	403
GPS	0	0	0	0	0	0	0	0
GVC	0	0	3	20	0	0	0	0
GWB	0	0	2	8	7	130	0	0
NCD	4	209	13	226	3	58	3	309
NCE	5	72	5	47	0	0	0	0
NDS	3	4	5	80	1	3	0	0
NMC	2	32	1	9	2	22	0	0
NSS	0	0	0	0	0	0	1	5
NTK	1	2	0	0	0	0	1	4
NTM	0	0	1	50	1	158	0	0
OSA[b]	0	0	0	0	0	0	0	0
OSG[b]	0	0	0	0	1	10	3	35
PDX	2	32	5	86	3	126	3	55
RCV	39	2434	3	1070	8	327	20	1272
RFI	1	40	0	0	0	0	0	0
TXR	43	5578	27	3834	18	3072	40	4505
UWV	17	2346	4	955	9	1933	2	73
UNK[c]	34	1894	20	1078	6	556	24	1057
Total	355	23224	216	16815	136	11155	197	15608
Hours		387		280		186		260

[a]Up to and including period 9 (September 30, 1984)
[b]Not a standard DSN abbreviation
[c]UNK: Unknown

Table 4. Tracking System outages by subsystem and by year

Year S/S	1981 No.	1981 Min.	1982 No.	1982 Min.	1983 No.	1983 Min.	1984[a] No.	1984[a] Min.
AES	0	0	0	0	0	0	0	0
ANT	95	5399	108	5049	66	3725	40	2996
APS	24	1159	20	426	15	263	29	894
DCD	0	0	1	94	1	1	0	0
DMC	3	643	2	80	2	54	2	30
DRG	2	2792	0	0	1	12	2	947
DRS	4	92	1	23	1	180	0	0
DTK	88	8170	43	5716	32	5199	32	4303
DTM	2	39	0	0	1	1	0	0
DTS	0	0	0	0	0	0	0	0
EXT[b]	0	0	0	0	0	0	0	0
FAC	30	1822	20	2101	20	2711	29	13125
FTS	2	114	7	648	4	398	5	499
GHS	31	621	9	154	7	43	9	243
GPS	1	2	0	0	0	0	0	0
GVC	1	20	2	19	0	0	0	0
GWB	0	0	2	8	0	0	0	0
NCD	0	0	0	0	0	0	1	15
NCE	5	67	4	40	0	0	0	0
NDS	3	44	2	41	0	0	0	0
NMC	3	144	0	0	0	0	0	0
NSS	0	0	0	0	1	56	1	5
NTK	3	58	4	43	4	155	2	16
NTM	1	31	0	0	1	158	0	0
OSA[b]	0	0	1	23	0	0	0	0
OSG[b]	0	0	1	20	2	62	9	68
PDX	9	364	10	268	5	395	3	44
RCV	59	3949	39	3128	46	3553	44	2422
RFI	4	196	11	291	20	297	4	178
TXR	18	1493	10	1045	15	919	19	1226
UWV	29	3836	17	3070	25	3906	12	1051
UNK[c]	46	8371	50	1624	20	1203	37	1040
Total	463	39426	364	23911	289	23291	280	29102
Hours		657		399		388		485

[a] Up to and including period 9 (September 30, 1984)
[b] Not a standard DSN abbreviation
[c] UNK: Unknown

Table 5. Telemetry System OMTBF, OMTTRS, and OFA by subsystem and by year

Year	1981			1982			1983			1984[a]		
S/S	OMTBF	OMTTRS	OFA	OMTBF	OMTTRS	OFA	OMTBF	OMTTRS	OFA	OMTBF	OMTTRS	OFA
AES												
ANT	444	0.91	99.7	266	0.74	99.7	379	1.1	99.7	485	1.05	99.7
APS	1498	0.34	99.9	1386	0.44	99.9	1946	0.29	99.9	735	0.49	99.9
DCD				15941	0.79	99.9	29190	0.02	99.9			
DMC	11983	0.47	99.9	7971	1.47	99.9	9730	0.61	99.9	7597	0.47	99.9
DRG							29190	0.05	99.9			
DRS	47932	0.13	99.9				14595	1.09	99.9	22790	0.17	99.9
DTK	11983	0.33	99.9	5314	0.48	99.9	4170	0.39	99.9	5698	0.28	99.9
DTM	705	0.7	99.9	602	0.91	99.8	621	0.23	99.9	351	0.95	99.7
DTS										22790	6	99.9
EXT[b]	23966	0.58	99.9									
FAC	1498	0.63	99.9	1449	0.84	99.9	1622	0.81	99.9	1424	0.61	99.9
FTS	11983	0.7	99.9	3985	1.38	99.9	7298	1.69	99.9	4558	1.5	99.9
GHS	1498	0.5	99.9	5314	0.19	99.9	4170	0.11	99.9	2072	0.62	99.9
GPS	47932	0.02	99.9									
GVC	47932	0.38	99.9	7971	0.88	99.9	14595	0.19	99.9			
GWB	9586	0.17	99.9	15941	0.07	99.9	29190	0.28	99.9	11395	0.58	99.9
NCD										22790	0.25	99.9
NCE	9586	0.24	99.9	6376	0.15	99.9						
NDS	15977	0.24	99.9	10627	0.26	99.9	29190	0.72	99.9			
NMC	23966	0.18	99.9	31882	0.37	99.9						
NSS							29190	0.35	99.9			
NTK	47932	0.03	99.9				29190	0.75	99.9	22790	0.08	99.9
NTM	11983	0.18	99.9				29190	2.63	99.9	11395	0.14	99.9
OSA[b]				31882	0.38	99.9						
OSG[b]				15941	0.28	99.9	29190	0.03	99.9	2532	0.14	99.9
PDX	6847	0.33	99.9	3985	0.33	99.9	4865	2.24	99.9	4558	0.24	99.9
RCV	599	0.95	99.8	523	0.97	99.8	429	0.84	99.8	456	0.98	99.7
RFI	2996	0.45	99.9	580	0.69	99.8	149	0.57	99.6	200	0.51	99.7
TXR	3195	1.58	99.9	3542	0.54	99.9	2433	0.93	99.9	1140	1.02	99.9
UWV	1198	2.01	99.8	1275	2.44	99.8	811	1.97	99.7	1899	1.42	99.9
UNK[c]	978	0.52	99.9	506	0.38	99.9	1460	0.4	99.9	465	0.58	99.8
System Total	93	0.81	99.1	66	0.8	98.8	55	0.77	98.6	51	0.75	98.5

[a]Up to and including period 9 (September 30, 1984)
[b]Not a standard DSN abbreviation
[c]UNK: Unknown

JPL DSN DISCREPANCY REPORT DR NO. C 2990

1. PRECEDENCE LEVEL (CHECK ONE) ☐ CLASS 1 ☐ CLASS 2 ☐ CLASS 3 | 2. CLASS 1 AUTHORIZATION | 3. ☐ FACILITY NOTIFIED ______ BY ______ DOY ______

4. LAST NAME FIRST M.I. | JPL EXT. | MAIL STATION | 5. DATE WRITTEN | 6. MASTER DR NO.

PROBLEM IDENTIFICATION

7. USER/PROJECT | 8. PASS NO./TEST | 9. TIME OF FAILURE/INCIDENT DOY ______ UTC ______ | 10. FACILITIES AFFECTED ______ ______ ______ ______ ______

11. DATA TYPE AFFECTED (FILL IN AS APPROPRIATE) (START UTC/END UTC)

IMPACT ON SYSTEMS →	TLM	TRK	CMD	MON	GCF	OTHER ______
DATA OUTAGE	/	/	/	/	/	/
DEGRADED DATA	/	/	/	/	/	/
RECOVERABLE DATA	/	/	/	/	/	/

SUSPECTED CAUSE OF PROBLEM (CHECK ALL APPLICABLE BOXES)

12. CATEGORY ☐ H/W ☐ S/W ☐ PROC ☐ DOC ☐ RFI ☐ UNKNOWN ☐ OTHER ______

13. FACILITY ☐ NDP ☐ NOCC ☐ GCF ☐ SPC ______ ☐ DSS ______ ______ ______ OTHER ______

14. SYSTEM ☐ FTS ☐ VLBI ☐ TRK ☐ TEST SUPPORT ☐ TLM ☐ MON & CONT ☐ CMD ☐ RADIO SCIENCE | 15. SUBSYSTEMS ______ ______ ______ ______ | 16. ASSEMBLY ______ ______ ______ | 17. CIRCUIT OUTAGE (COMM ONLY) FROM ______ TO ______ TOTAL OUTAGE ______

18. DESCRIPTION OF PROBLEM/FAILURE/INCIDENT (DESCRIBE IN AS MUCH DETAIL AS POSSIBLE)

19. RELATED DOCUMENTS AND REPORTS
FR ______ WLC ______
ISA ______ OTHER ______

☐ ADDITIONAL DATA ATTACHED

INITIATOR

20. REAL TIME RESTORE AND CLOSEOUT ACTION
☐ WARM LOAD ☐ COLD LOAD ☐ SYSTEM SWAP ☐ POWER RESTORE ☐ EQUIPMENT SWAP ☐ CIRCUIT SWAP ☐ OTHER ______

SEF (Y/N) ☐

21. SUBSYSTEM STATUS ☐ COMMITTED H/W OR S/W ☐ R&D H/W OR S/W | 22. PROBLEM FAULT ☐ FACILITY DEPENDENT ☐ FACILITY INDEPENDENT ☐ UNAVOIDABLE ☐ OTHER ______

CLOSE OUT

23. ASSIGNED TO ☐ OC&S ☐ PAG ☐ OTHER ______ | DATE | 24. APPROVAL | DATE

REASSIGNED TO ☐ OC&S ☐ PAG ☐ OTHER ______ | DATE | 25. CLASS 1 APPROVAL | DATE

CONTROL

JPL 0166 R9/84

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Fig. 1. DSN Discrepancy Report form

AUG 30,84 DSN STATION UTILIZATION SUMMARY REPORT FOR WEEK 33 - 33 PAGE 1

	12		14		42		43		61		63		TOTAL	
	SOH	EUH	SOH	EUH	SOH	EUH	SOH	EUH	SOH	EUH	SOH	EUH	SOH	EUH
1A1														
PN-10	2.5	1.5	0.0	0.0	0.0	0.0	34.5	29.7	5.1	3.6	18.3	15.3	60.5	50.3
PN-11	33.0	27.5	0.0	0.0	35.6	30.0	5.6	4.9	26.6	22.9	0.0	0.0	101.0	85.4
PN-12	25.5	21.0	0.0	0.0	22.3	17.5	0.0	0.0	40.3	35.0	3.7	3.0	91.9	76.6
HEL-01	18.5	14.0	0.0	0.0	0.0	0.0	0.0	0.0	8.5	6.3	0.0	0.0	27.1	20.4
ICE	0.0	0.0	0.0	0.0	0.0	0.0	25.2	20.7	0.0	0.0	47.2	40.2	72.5	61.0
ACCE	0.0	0.0	0.0	0.0	0.0	0.0	21.0	11.1	24.1	19.6	0.0	0.0	45.1	30.8
AIRM	53.7	41.2	0.0	0.0	33.1	25.1	0.0	0.0	0.0	0.0	25.7	19.7	112.6	86.1
AUKS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.4	12.1	14.4	12.1
VGR-01	0.0	0.0	0.0	0.0	4.7	4.0	18.9	16.9	4.0	3.3	7.1	6.4	34.9	30.6
VGR-02	8.4	7.4	0.0	0.0	12.2	11.5	20.8	17.8	2.5	2.0	32.0	23.3	76.0	62.0
1A4	9.0	5.5	0.0	0.0	0.0	0.0	4.5	3.0	0.0	0.0	0.0	0.0	13.5	8.5
TOTAL 1A	150.8	118.3	0.0	0.0	108.1	88.3	130.6	104.3	111.5	93.0	148.7	120.2	649.9	524.2
APCT*	87.5	100.0	0.0	0.0	67.6	100.0	81.7	100.0	70.3	100.0	88.5	100.0		

NOTE:

APCT:TOTAL 1A/GD.TOTAL PER STATION
1A1:SPACECRAFT TRACKING
1A2:PROJECT RELATED SUPPORT
1A3:DSN PROJECT PREPARATION
1A4:MULTIMISSION SUPPORT

SOH:STATION OPERATING HOURS
1B1:RADIO SCIENCE-OSSA
1B2:RADIO SCIENCE-RAES
1B3:RADIO SCIENCE-OSTDS
1B4:RADIO SCIENCE-OA

EUH:END USER HOURS
1C1:ADVANCED SYSTEM-OSTDS
1C2:ADVANCED SYSTEM-OSTDS SPE.
1D1:SPECIAL

Fig. 2. Sample DSN station utilization summary report