Summary of DSN Reimbursable Launch Support

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The DSN is providing ground support to space agencies of foreign governments as well as to NASA and other agencies of the federal government which are involved in space activities. DSN funding for support of missions other than NASA are on either a cooperative or a reimbursable basis. Cooperative funding and support are accomplished in the same manner as NASA-sponsored missions. Reimbursable launch funding and support methods are described.

I. Introduction

This article is a summary of how the DSN provides support for NASA reimbursable missions. Tables 1, 2, and 3 provide a summary of the missions that have been completed, approved missions to be supported in the near future, and the new proposed mission set. The tables list the missions, the responsible agency, the launch vehicle and launch site, the original and current launch dates, and the support period.

The process begins when other space agencies request NASA ground station support for the launch of their spacecraft. Normally the spacecraft are geostationary communications satellites, but they could range from low earth orbiters to deep space missions. Normally, a preliminary Support Instrumentation Requirements Document (SIRD) is sent to NASA by the requesting foreign agency. NASA tasks JPL to review the preliminary SIRD and to provide a cost estimate. NASA then attaches this estimate to the agreement with the foreign agency, and with that begins the DSN support commitment.

II. Prelaunch Preparation

A. Mission Support Documentation

1. **NASA Support Plan (NSP).** The Tracking and Data Systems Manager is responsible for the NSP. The NSP responds to the SIRD and represents NASA's commitment to the project.

2. **Network Operations Plan (NOP).** The Network Operations Project Engineer (NOPE) is responsible for the NOP. The NOP provides the operational procedures for project support.

3. **Interface Control Document (ICD).** The ICD is jointly prepared by the project and JPL. The project normally takes the lead and publishes the document. The ICD outlines the agreed-to data interfaces between the project and the DSN.

4. **Data Input Package (DIP).** The DIP is provided by the project. The DIP gives the DSN supporting organization de-

tailed information about the spacecraft, the network coverage profile, and the Sequence of Events (SOE).

5. Initial Acquisition Plan (IAP). The IAP is provided by the DSN. The IAP documents the initial acquisition procedure to be used by the DSN station or stations supporting the initial acquisition of signal after launch.

B. Tests and Training

Compatibility tests signal the start of the test and training phase, which begins about 12 to 14 months prior to launch and continues through the final prelaunch readiness test. Compatibility testing ensures that the spacecraft and the DSN ground stations are compatible. The project provides the compatibility test plan and the test criteria, while the DSN provides the compatibility test procedures. At the completion of the compatibility test, a test report is written documenting the test results.

Data flow tests are conducted at about launch minus 6 months. Their purpose is to verify that the project and DSN data interfaces are correct and work in the operational environment.

Ground data system tests are conducted at launch minus 2 months. These tests bring together all the supporting elements, which include the 26-m subnetwork, 34-m backup stations, DSN control center, project control center, NASCOM data/voice circuits, DSN operations control team, and project operations control team. The objectives of the ground data system tests are to test and verify all elements of the mission support systems and to provide operational training for all test participants.

Operational readiness tests are conducted at launch minus 1 month. They ensure that all supporting elements and teams are operationally ready to support the mission while also providing additional training for the mission support teams and a final check-out of operational procedures.

Initial acquisition tests are conducted at launch minus 2 weeks. The tests provide a check-out of the initial acquisition procedure, initial acquisition configuration, and operational team training.

Prelaunch data flow tests are conducted at launch minus 3 days and 1 day. These tests verify that the launch configuration for all elements of mission support are correct. The tested configuration is placed under configuration control to ensure that nothing changes prior to launch.

III. Working Group Meetings

A minimum of two working group meetings are held each year. One meeting is held at JPL, and one is held at the headquarters of the foreign agency. The meetings provide an excellent environment for the exchange of information between the project and the DSN operations and engineering personnel.

IV. Launch Support

On launch day, the worldwide communications circuits are in place at launch minus 3 hours. Status information is exchanged between the project and the DSN every half-hour.

The station prepass countdown is activated at launch minus 2 hours. The prepass preparations ensure that the stations are ready and properly configured for launch support. At launch plus 15 minutes, the stations are briefed on the upcoming acquisition support and are given any updates to the sequence of events or predict set to be used for initial signal acquisitions.

Most of the reimbursable missions supported by JPL are geostationary communications or broadcast satellites. A typical support period for launch, transfer, and drift orbit is 5 to 7 days. The project notifies JPL when mission support is completed and is to be terminated.

V. DSN Operations Launch Readiness Review

To ensure that all the necessary planning, testing, and training has been accomplished prior to a reimbursable mission launch, a formal Launch Readiness Review is held. The purpose of these reviews is to verify that any required implementation is complete and that an adequate test and training plan is in place and on schedule, with completion appropriately planned to accommodate the launch date.

VI. Special Precautions

The DSN takes special precautions for all critical activities to ensure readiness to provide the support required for mission success. It also investigates contingencies that could enhance the probability of mission success. The following paragraphs discuss several special precautions that are taken to ensure reimbursable mission success.

After the successful completion of the last launch rehearsal or launch operations readiness test (a few days before launch), the supporting DSN facilities (prime and backup stations and the control center) are placed under Modified Configuration

Control (MCC). MCC requires that DSN facilities obtain the approval of DSN Operations management before making configuration changes other than remove-and-replace in support of maintenance.

To provide maximum network reliability to the reimbursable missions, the DSN operates the supporting stations on diesel-generator power as opposed to commercial power. The Space Flight Operations Facility diesel generators are also operated at the request of the DSN to protect the Network Operations Control Center (NOCC) power integrity during the critical periods of the reimbursable mission support.

Station predicts, schedules, and sequences of events are created and transmitted by the Network Support Subsystem (NSS). During the launch phase, the ability to generate new predicts quickly based on updated launch parameters is critical to rapid and successful initial acquisition at the stations. Therefore, several precautions are taken to ensure that the NSS is available and not overloaded during the launch phase. Special on-call maintenance is contracted during the critical periods; the VAX System Manager or assistant is always on duty during critical periods; priorities of work are established and promulgated prior to the launch; nonessential work is deferred; and dial-up utilities are disabled as part of the availability and reliability enhancement activities.

The DSN multimission navigation facility uses pointing vectors from various external agencies as well as DSN station radio metric data to generate predict files that are sent to the NSS for predict generation. Therefore, this critical resource is protected in much the same manner as the NSS, as described above.

Communications circuits between JPL and the stations are provided special contracted maintenance during the critical periods to ensure rapid recovery of circuits in case of failures.

At both the Control Center and the stations, technical specialists back up the operations crews on an advisory basis during critical activities to ensure rapid recognition of problems as well as rapid recovery.

Finally, to ensure that all personnel within the DSN as well as users of the DSN are aware of scheduled critical reimbursable mission launch activities, an awareness notification message is sent to all DSN facilities and to all projects using the DSN.

Table 1. Completed missions

Mission	Agency	Launch vehicle	Launch site	Original/ prepared launch date	Actual launch date	End support period
MS-T5	ISAS	M3S-2	KAG[a]	1/1985	1/7/85	1/17/85
MS-T5	Additional support					10/26/86–12/10/86
Giotto	ESA	Ariane-1	KRU[b]	7/1985	7/2/85	3/18/86
PLANET-A	ISAS	M3S-2	KAG	8/1985	8/19/85	8/27/85
PLANET-A	Additional support					3/25/87–4/15/87
BS-2B	NASDA	N-2	TAN[c]	8/1985	2/6/86	2/11/86
ASTRO-C	ISAS	MU-3S2	KAG	2/1987	2/7/87	2/8/87
ETS-V	NASDA	H-1	TAN	8/1987	8/27/87	9/1/87
TV-SAT	GSOC	Ariane-2	KRU	4/1985	11/20/87	11/23/87
CS-3A	NASDA	H-1	TAN	2/1988	2/19/88	2/22/88
TC1-C	CNES	Ariane-3	KRU	7/1986	3/11/88	3/13/88

[a]KAG = Kagoshima, Japan
[b]KRU = Kourou, French Guiana
[c]TAN = Tanegashima, Japan

Table 2. Approved mission set

Mission	Agency	Launch vehicle	Launch site	Original/ proposed launch date	Current launch date	Prime support period
CS-3B	NASDA	H-1	TAN[a]	8/1988	9/14/88	L + 5 days
TDF-1	CNES	Ariane-2	KRU[b]	8/1985	10/7/88	L + 8 days
DFS-1	GSOC	Ariane-3/4	KRU	9/1987	11/4/88	L + 8 days
TELE-X	CNES	Ariane-2/4	KRU	12/1987	3/1/89	L + 8 days
GMS-4	NASDA	H-1	TAN	8/1989	8/1/89	L + 5 days
EUTELSAT II-F1	GSOC	Ariane-3/4	KRU	10/15/89	1/15/90	L + 8 days

[a]TAN = Tanegashima, Japan
[b]KRU = Kourou, French Guiana

Table 3. Proposed missions

Mission	Agency	Launch vehicle	Launch site	Proposed launch date	Current launch date	Prime support period
EXOS-D	ISAS	MU-3SII-4	KAG[a] (JKSC)[b]	2/1/89	2/1/89	L + 1 day
TDF-2	CNES	Ariane	KRU[c]	4/1989	9/15/89	L + 8 days
DFS-2	GSOC	Ariane	KRU	4/1989	9/15/89	L + 8 days
TV-SAT 2	GSOC	Ariane	KRU	10/1989	5/10/89	L + 8 days
BS-3A	NASDA	H-1	TAN[d]	10/1989	8/1/90	L + 5 days
BS-3B	NASDA	H-1	TAN	8/1991	8/1/91	L + 5 days
SFU	ISAS	H-2	KAG (JKSC)	1/1993		L + 7 days and STS recovery 7 days

[a]KAG = Kagoshima, Japan
[b]JKSC = Japanese Kagoshima Space Center
[c]KRU = Kourou, French Guiana
[d]TAN = Tanegashima, Japan