Networks Consolidation Program

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The Networks Consolidation Program (NCP) was established by NASA in 1979 to implement recommendations of the Networks Planning Working Group which were presented at NASA Headquarters in October of that year. The goals of the NCP were defined to include the planning, designing and implementing of a single consolidated network of ground tracking stations to replace the present two ground-based spacecraft tracking networks.

The proposed consolidated network will make use of some facilities that are now included in the Ground Spaceflight Tracking and Data Network (GSTDN), operated by Goddard Space Flight Center (GSFC), as well as the existing Deep Space Network (DSN), operated by Jet Propulsion Laboratory (JPL). These facilities will be combined and modified to provide a consolidated network managed and operated by JPL and capable of supporting the set of planetary and Highly Elliptical Earth Orbiter (HEEO) missions planned for the Tracking and Data Relay Satellite System (TDRSS) era.

The consolidated network will come into being after the TDRSS becomes operational. It will continue to support planetary missions that are now supported by the DSN and also provide support to a broad class of other spacecraft missions which are not compatible with or which, for other reasons, cannot be supported by the TDRSS.

A previous report in the TDA Progress Report series traced the history of activities and events that led to the decision to consolidate the NASA ground tracking and data networks into a single network. It included a summary of the NCP management and planning activities that have taken place at Jet Propulsion Laboratory, Goddard Space Flight Center, and at the NASA Headquarters Office of Space Tracking and Data Systems (OSTDS), from the October 1979 decision to proceed to August 1980. This report shows the progress of the NCP since the previous report to the present with special emphasis on the planning and budgeting activities that have occurred.

I. Introduction

The first progress report on the Networks Consolidation Program (NCP) appeared in *The Telecommunications and Data Acquisition Progress Report 42-59* (Ref. 1). It included a history of the development of the NCP from the initial meetings of the Networks Planning Working Group through activities completed in August 1980. This report addresses management, design, and implementation activities that have occurred since the previous article.

II. Program Accomplishments

A. NCP Organization

When the decision was made to proceed with the NCP as a major NASA program, two teams were formed at JPL to do planning and design tasks. A Planning Team, with representatives of involved organizations at JPL, was chartered to develop program guidelines and plans. A System Design Team, with representatives from the implementation and operations organizations, was formed to develop system functional requirements, system designs, implementation alternatives and plans. A third team was formed for execution of the implementation of the plan when the first two teams completed their work. This team, the Implementation Team, has absorbed the functions of the System Design Team, and operates under the direction of a manager who is responsible for all NCP implementation activities. In addition, a Steering Committee was formed to provide support, review, and advice to the NCP Manager on a continuing basis. It reviews progress of planning, design, and implementation tasks and makes recommendations to the program manager. It also conducts special studies to help the NCP Manager make informed decisions when considering proposals regarding implementation alternatives.

B. Formal Reviews

A series of formal reviews was established at which the program management reported on planning, design and implementation activities of the program. Two of the reviews were reported in Ref. 1. Two others were held during the period of this report. The third review covered the functional designs of the systems and subsystems that will make up the consolidated network. This review was rated as "very well done" by the review board, although there were many "requests for action" submitted by attendees and board members.

Two points were raised and discussed. One was that NASA OSTDS had directed NCP management to consider the addition of requirements for backup support to the Space Shuttle, TDRSS, and certain HEEO missions. Since these extensions had not been considered in the baseline mission set, the review board recommended that a special team be formed to study the impact to NCP plans of adding these requirements. They further advised that this effort should be kept apart from, and operate in parallel with, the main design activities and should not interfere with the baseline effort. The second point was that the overall plan appeared to be success oriented, with little visible schedule contingency.

The fourth formal review covered the Networks Consolidation Implementation Organization and Plan. The board was asked if the plan was adequate to accomplish the networks consolidation goals and if it would recommend that the program should proceed.

The review board noted that the review was excellent in format and detail; they recommended that the program should proceed according to the implementation plan. They did take special note of the continuing growth of requirements beyond the original baseline and the continuing level of schedule contingency visible in the plan. It was agreed that a fifth program review should be scheduled after completion of the special parallel study, initiated during the third review. It was felt that this added review should lead to recommendations regarding the inclusion or rejection of proposed extensions to the NCP baseline mission set. The fifth review, which will follow the format and agenda of the fourth review, is scheduled for October 21-22, 1981.

C. Budgets

The budgetary picture of the NCP came to a first level of completion in a presentation to the NASA Comptroller in July 1980. In preparing for that presentation, all of the major tasks for the NCP were identified and costed in such a manner as to be consistent with the overall budget that Headquarters had allocated to the program. It should be noted that the cost structure was based on materials presented in Ref. 2. These included assumptions regarding management organization, station equipment availability, mission support requirements and schedules for all affected missions.

In recent months the program has experienced a succession of changes in most of the areas in which assumptions had been made. Overall funding levels have been modified to reflect changes in mission schedules – some have slipped and some have been cancelled – and budgetary reductions brought about by decisions of the new Administration. Overall, NCP costs remain within the boundaries estimated in July 1980.

D. Antenna Array Alternatives

The report of the working group (Ref. 1) included the Large Advanced Antenna System (LAAS), an array of new 40-meter antennas, as an element of the consolidated network. This antenna array, which was to provide increased telemetry

capability for support of the Voyager spacecraft at Uranus encounter, was to be at the Goldstone, California, DSN complex. Since the LAAS will not be developed, the NCP must initiate a plan to array antennas at each complex and to develop the additional antennas needed to provide the effective aperture to support Voyager Uranus data requirements.

Initial plans for antenna arraying included colocation of all the antennas at each complex to the locations of the present 64-meter antennas and conversion of all 26-meter antennas to 34-meter antennas. Colocation has been questioned from two major points of view. First is the question of overall costs. Studies show the higher front-end costs of moving the antennas to a central point at each complex are quickly offset by savings in the continuing maintenance and operations costs when compared to the costs of continuing staffing and support at the present diverse locations. Thus from a cost standpoint the better course of action is to colocate antennas. A second concern was radio frequency interference (RFI) among the colocated antennas. This question has been studied by systems and engineering personnel. The study shows that the potential for RFI is not sufficient to deter the decision to colocate the antennas at a complex.

The types and number of antennas planned for each complex after the networks consolidation is completed are:

1 64-meter antenna:	the existing antenna in its present location
1 34-meter antenna:	the existing antenna which has been converted from a 26-meter antenna, relocated to the site of the 64-meter antenna
1 9-meter antenna:	the existing 9-meter antenna, relocated to the site of the 64-meter antenna
2 34-meter antennas:	representing the residual 26-meter antennas from the GSTDN and the 26-meter subnet of the DSN, each converted to 34-meter antennas and relocated to the site of the 64-meter antenna

There is a question of whether it is better to convert 26-meter antennas to 34-meter antennas or to procure new antennas which would be installed directly at the colocated sites. This is now being studied and includes questions of life-cycle costs and comparison of technical capabilities of the competing antenna alternatives. No firm decision on this point has been made.

E. Mission Set

The initial networks consolidations planning showed TDRSS, once it became operational, providing support to all low earth-orbital missions. The remaining or ongoing high earth-orbiting or libration-point missions would remain the responsibility of the residual GSTDN stations until those stations were closed or converted for inclusion in the consolidated network. It was assumed that only the Origins of Plasma in the Earth's Neighborhood (OPEN), the Active Magnetospheric Particle Tracer Experiment (AMPTE), and the International Sun-Earth Explorer (ISEE-3) missions from this class would continue to require support beyond that time. The DSN would continue to support all planetary or deep space missions. The new consolidated network would accept continuing responsibility for support of planetary and a limited set of high earth-orbiting missions. It would not support any low earth-orbital missions. Any such missions which were not compatible with TDRSS were expected to terminate. The mission set to be supported by the consolidated network was restricted to the prime mission periods for the missions identified in Fig. 1-3 of Ref. 2 and no other missions were included in the baseline set.

As previously noted, OSTDS has directed program management to evaluate the cost, schedule, and capability impacts associated with the addition of some missions to the baseline. This effort is now underway and will be addressed in future program reviews. A copy of the current NCP Mission Set is shown in Fig. 1.

F. Transition Plan

The first edition of the Transition Plan was completed in January 1981 and has been used in initial transition planning activities. Owing to the large number of actual and proposed changes in the scope of NCP mission coverage and in the dates of coverage that will be required, the original version of the plan has been revised and was published in June 1981.

The accomplishment of the Networks Consolidation Program will require an extensive effort to permit the transfer of responsibility for support of individual projects from the GSTDN to either the TDRSS or to the new consolidated network in such a way as to assure that there will be no adverse impact on the flight projects. The NCP Transition Plan, Volume II of the series of NCP plans, will control the transition

process. It will encompass the phasing over of management functions and technical support, as well as the transfer of equipment from the GSFC-managed STDN stations to the JPL-managed Consolidated Network.

G. Mission Support Plan

The development of a Mission Support Plan for the NCP commenced during the second quarter of FY 1980. This task has involved a major effort to determine the network load that must be supported by the consolidated network. The state of flux that has affected the NCP Baseline Mission Set has had a resulting effect in the determination of network loads which cannot be considered firm until the mission set stabilizes.

Based on all available information, the first draft of the Mission Support Plan was released for review and comment. The document is now in the final stages of the approval cycle and will be released in September 1981.

H. Implementation Plan

The development of the NCP Implementation plan commenced in the third quarter of FY 1980 under the auspices of the NCP System Design Team. This effort progressed through the end of the fiscal year and resulted in the release of the first draft of the plan in January 1981. This draft represented the basic implementation concepts for the consolidated network as they were presented at the fourth formal review of the program. A second draft of the plan has been prepared and is being circulated for internal review and comments. This document is subject to further changes as decisions are made with respect to antenna alternatives and mission support requirements. Figure 2 represents the current status of the NCP planning and design schedule as developed in the implementation plan.

References

1. Layland, J. W., "OSTDS Networks Planning for the TDRSS Era," OSTDS Report, Office of Space Tracking and Data Systems, NASA, Jan. 1980.
2. Yeater, M. L., Herrman, D. T., and Sanner, G. E., "Networks Consolidation Program," *TDA Progress Report 42-59, July and August 1980*, p. 107, Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1980.

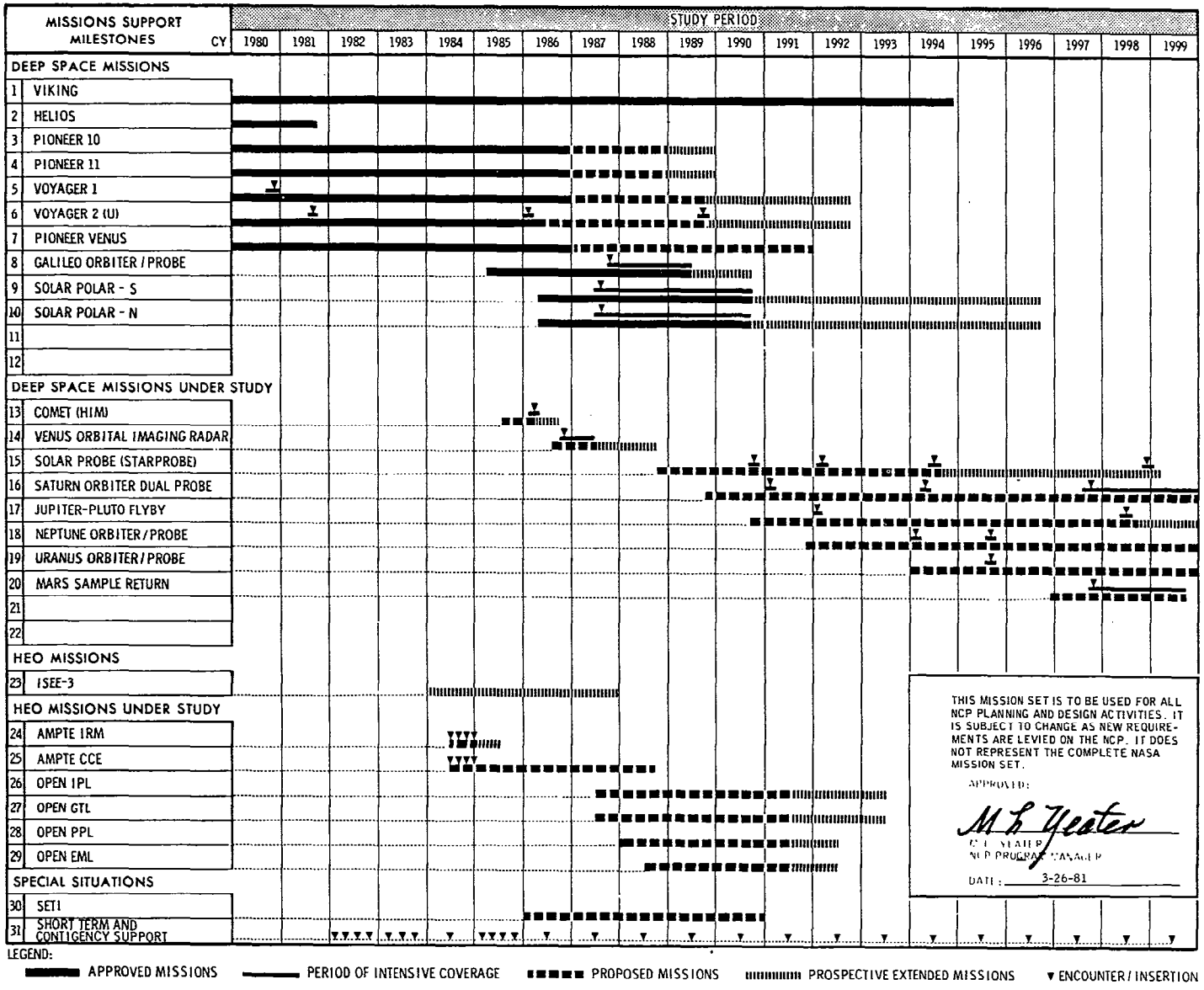

Fig. 1. NCP flight mission set

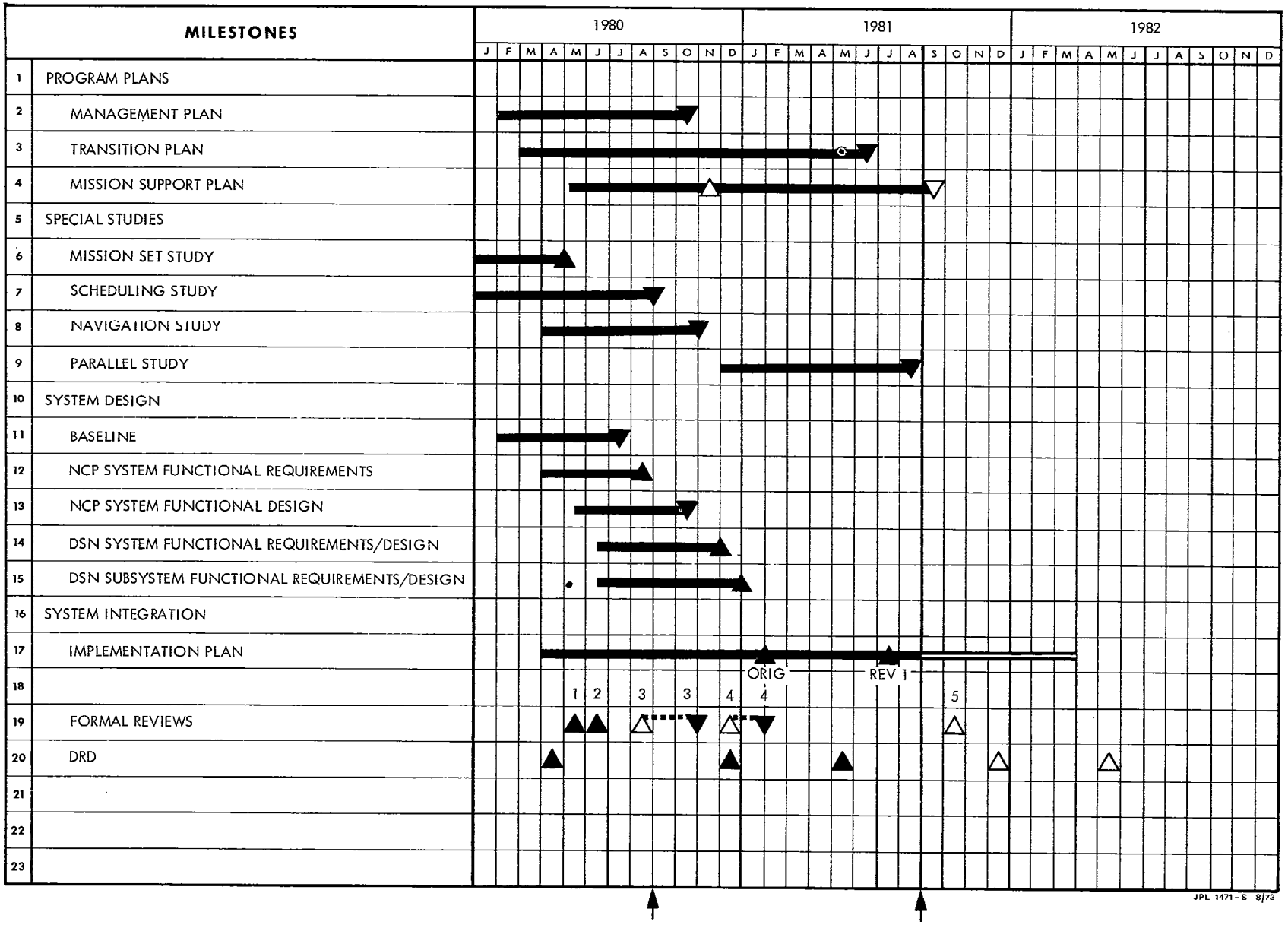

Fig. 2. Planning and design schedule