

PLANETARY PROGRAM DATA SYSTEMS STANDARDS

EARL W. GLAHN

Planetary Programs Data Systems Working Group.

The planetary program data systems at NASA include the complete data link to and from a planetary or interplanetary spacecraft and the data processing computers on the ground. The functions performed by the data systems are spacecraft tracking, telemetry and command. Although there have been design constraints placed on these systems in the past, such as the transmission frequencies used, no standards have been available which apply to these systems.

Planetary data systems are somewhat different from earth orbital systems and are becoming more complex because of the requirement for data transmission over steadily increasing planetary distances. For example, Pioneer 10, now on its way to Jupiter, will have to communicate over distances up to 575,000,000 miles with a round trip communication time of about 2 hours. Also, almost all planetary spacecraft include various kinds of coding, such as block coding or convolutional coding, to gain higher link efficiency and all data is transmitted as digital rather than analog data. Thus the planetary programs during the 1970-1980 period are requiring significant new developments in the data systems area. It is necessary that these new developments be controlled in such a manner as to insure the most cost effective and technically feasible implementation, and to maintain compatibility between the spacecraft and the ground elements of the systems.

In 1969 it was decided to start an effort to develop standards to apply to the planetary program data systems. This effort was initiated with the formation of a working group, now known as the Planetary Program Data Systems Working Group, under the joint direction of the Office of Space Science (OSS) and the Office of Tracking and Data Acquisition (OTDA) at NASA Headquarters. Membership on the group includes project representatives and representatives of each of the data systems involved. Thus, the spacecraft system, the deep space network, the ground communications facility and the computer processing system are all represented.

During the early meetings of the group much time was occupied with discussion of what standards really were, and if and how standards could really be applied to the planetary program data systems. Also, we discussed whether we should use the term "standards" or use some other term like "guidelines" or "design criteria". Currently we are using the term standards, but this subject is still undergoing periodic discussion.

The development of standards began with a review of the existing design of the data systems elements. As stated earlier, certain constraints such as the transmission frequencies constitute automatic standards. The task then became the identification of other elements of the systems which could be candidates for additional standards. Previous work, such as the GSFC Aerospace Data Systems Standards effort, was used to provide examples of other elements which could be candidates and examples of the type of document which might be produced. This effort proceeded rather slowly and it took about two years to get agreement on a preliminary list of items which were considered legitimate candidates.

In 1972 a Telecommunications Standards Committee was formed, sponsored by Headquarters and reporting to the working group, to devote full time effort to the final preparation of the standards. Due to the work of that committee, we have now developed preliminary standards for the radio frequency transmission and telemetry systems. The radio frequency transmission section and a part of the telemetry section have been officially distributed and comments have been received. We are now in the process of negotiating revisions based on these comments and expect to issue these portions in the near future. This issuance will be in the form of a distribution letter to the users signed by the Associate Administrators for OSS and OTDA.

The method of enforcement of the standards also has been the subject of much debate. Each planetary project is required to have a document called the Project Plan approved by NASA Headquarters before official project authorization. It is our current proposal to require that each future Project Plan identify those standards which will be applicable to the project, and those which will not be applicable together with a reference to the approved waiver request.

Our plans for evaluation and approval of waiver requests have not been firmly established. Tentatively, we believe that these requests can be evaluated by the working group who in turn will make recommendations to management for final action. In any event, we do recognize that a clear waiver process must be established. It is our intent to establish such a process and to issue waiver request instructions with the first part of these standards mentioned earlier.

Our future activity will be concentrated on development and issuance of standards for the rest of the telemetry system and the command, central processing and tracking systems. We hope to have a reasonable complete set of standards developed within about a year. These areas which we now see as being the most difficult are those involving data structuring and data coding aboard the spacecraft since these involve very obvious but hard to measure trade-offs between the spacecraft and the ground elements of the data systems. These trade-offs are now being studied.

We expect to have some opposition and reluctance on the part of the various systems to accept and implement the standards. Much of this will stem from real resource limitations. We have no answer to this problem now and propose to treat such opposition on a case by case basis. It is encouraging to note that all systems admit the need for standards and have shown a very active interest in the working group discussions. Through their direct participation they have been and will continue to be exposed to various spacecraft/ground trade-off studies. Such studies are now being considered by the Mariner Jupiter Saturn 1977 project in the design of their spacecraft which is now taking place in parallel with the working group activity. Thus we believe that our effort will result in some degree of informal standardization even without the existence of formal documentation. However, it is our intent to continue in the direction of developing and implementing a complete set of standards as soon as possible.