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16. ABSTRACT The Space Physics Analysis Network or SPAN is emerging as a viable method for solving an immediate communication problem for the space scientist. SPAN provides low-rate communication capability with co-investigators and colleagues, and access to space science data bases and computational facilities. The SPAN utilizes up-to-date hardware and software for computer-to-computer communications allowing binary file transfer and remote log-on capability to over 25 nationwide space science computer systems. SPAN is not discipline or mission dependent with participation from scientists in such fields as magnetospheric, ionospheric, planetary, and solar physics. This document provides basic information on the network and its use. It is anticipated that SPAN will grow rapidly over the next few years, not only from the standpoint of more network nodes, but as scientists become more proficient in the use of telescience, more capability will be needed to satisfy the demands.					
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TECHNICAL MEMORANDUM

INTRODUCTION TO THE SPACE PHYSICS ANALYSIS NETWORK (SPAN) - FIRST EDITION

I. HISTORY OF THE SPAN AND DSUWG

A considerable evolution has occurred in the past two decades in the disciplines of Solar-Terrestrial and Interplanetary Physics. Early research was centered around exploratory missions in which measurements from individual scientific instruments could be meaningfully employed to advance the state of knowledge. As these scientific disciplines have progressed, a much more profound and interrelated set of questions is being posed by researchers. The result is that present-day investigations are generally much more complex: large volumes of data are acquired from multiple sensors on individual spacecraft or ground-based systems, and quite often, data are needed from multiple sources in order to address particular physical problems.

It is clear that research in solar-terrestrial physics during the 1980s and beyond will be devoted to intense multi-disciplinary studies aimed at exploring very complex physical questions. It is recognized that major future advances in solar and space physics will require close collaboration among investigators through interactive exchange of scientific information. The problems of data exchange are exacerbated by the lack of standards for scientific data bases. The net result is that, at present, most researchers recognize the value of multi-disciplinary studies, but the cost in time and effort is devastating to their research efforts. This trend is antithetical to the needs of the NASA research community.

In May 1980 the Space Plasma Physics Branch of the Office of Space Science of NASA Headquarters funded a pilot project at Marshall Space Flight Center (MSFC) to investigate ways of performing correlative space plasma research on a daily basis on a nationwide level. As a first step, a user group was formed called the Data Systems Users Working Group (DSUWG) to provide space science community interaction and direction in the project. After the first meeting of the DSUWG in September 1980, it was decided that the approach would be to design, build, and operate a network that would be a data system testbed which would be specifically mission independent. In addition, the construction of the system would be designed to use existing hardware as much as possible and take full advantage of "off the shelf" software and hardware.

The Space Physics Analysis Network (SPAN) first became operational in December 1981 with three major nodes: University of Texas at Dallas, Utah State University, and MSFC (under the name MSFC/NEEDS Network and later under the name Space-plasma Computer Analysis Network or SCAN). Since that time it has grown rapidly (see Section II). SPAN has developed largely within the space plasma physics community through grass-roots efforts to facilitate space data analysis by providing electronic mail, document browsing, access to distributed data bases, facilities for numeric and graphic data transfer,

access to Class VI machines, and entry to gateways for other networks. At present, SPAN is built on a VAX-based central node which was implemented as a technology testbed for high rate data capture and archiving (see for example, Thomas [1]). The emphasis of the SPAN is determined by the DSUWG. SPAN presently uses existing Digital Equipment Corporation computers as network nodes (usually already paid for by NASA for a wide variety of missions) and communicates over leased lines using the DECnet protocol.

SPAN provides a common working environment for sharing of computer resources, sharing of computer peripherals, solving proprietary problems, and providing the potential for significant time and cost savings for correlative data analysis (see Green et al. [2] and Green [3]). The DSUWG continues to provide guidance for SPAN growth and seeks to use standardization for the efficient exchange of data and graphics. The DSUWG is drawn from its present and potential user community as well as other interested, active scientists and data system managers. It has been continuously active since 1980 providing guidance to the Solar Terrestrial Division (now the Space Plasma Physics Branch of the Earth Science and Applications Division) in NASA's Office of Space Science and Applications (see Greenstadt and Green [4], Baker et al. [5], Green et al. [6] and Green et al. [7]).

The DSUWG is structured along lines conducive to addressing major outstanding problems of scientific data exchange and correlation. There is a chairman for each subgroup to coordinate and focus the group's activities and the Project Scientist (J. L. Green) to oversee the implementation of the DSUWG recommendations and policies. The working group itself is divided into several subgroups which address issues of policy, networking and hardware, software and graphics standards, and data base standards. Appendix A is a detailed list of the DSUWG membership organized by subgroups.

The DSUWG is a dynamic, evolving organization. We expect members to move in (or out) as appropriate to their active involvement in data related issues. We also realize that at present SPAN and the DSUWG are dealing with only a limited portion of the whole spectrum of problems facing the NASA community. As present problems are solved, as the network evolves, and as new issues arise, we look to the DSUWG to reflect these changes in its makeup, its structure, and focus.

II. PRESENT CONFIGURATION OF THE NETWORK

SPAN links together computers in the United States (and Europe in the near future) which are used for space physics data analysis. The SPAN currently reaches across the continental United States, coast to coast and border to border (see Fig. 1). At this time (March 1985), there are 20 computers that are a part of the SPAN. This includes machines as small as a PDP-11/23+ and as large as a dual processor VAX 11/782 and a VAX Cluster. Nearly all of the machines are linked together using the commercially available software package DECnet. DECnet allows suitably configured Digital Equipment Corporation (DEC) computers (PRO's, PDP's, VAX's, and DECSYSTEM's) to communicate across a variety of media (fiber optics, coax, leased telephone lines, etc.) utilizing a variety of low level protocols (DDCMP, Ethernet, X.25). There are also several institutions that are currently connected to the central computer as simple computer terminals.

The topology of SPAN is best described as a modified star (Fig. 2). The NEEDS VAX located at MSFC is at the center of the star with most other network machines connected to it over leased telephone circuits that radiate from the NEEDS VAX. Several institutions have local area networks that allow a number of different machines to be connected to SPAN. Regardless of a machine's position in the network (either physical position in the US or logical position within the network), each machine sees all the other machines as "equals." A SPAN node that is located across the country and is reachable by linking through five intermediate nodes is as transparently accessible as a SPAN node sharing the same machine room with the originating system.

SPAN is currently using a number of different physical communications technologies. The media used most often for wide area links is ATT Communications (ATTCOM) Digital Data Service (DDS) at 9.6 kb/s. Several wide area links use ATTCOM's older analog Dataphone II service at 4.8 and 9.6 kb/s. Local links typically use some sort of high speed communications. Examples are the 56 kb/s fiber optics link between NEEDS and SSL, the 19.2 kb/s Local Area Data Service link between NEEDS and MIPS1, the 1 Mb/s DMR-DMR link between PACF and NSSDC, and the 10 Mb/s Ethernet links used at STARLAB. While the communications technologies differ, the software protocol, DECnet, remains the same at the user level.

There are several capabilities and features that SPAN is developing, making it unique within the space science community. The SPAN system provides remote users with access to space science data bases and brings scientists throughout the country together in a common working environment. Unlike all past and present space science networks, where the remote sites have only remote terminals (supporting one person at the remote site at a time), SPAN supports many users simultaneously at each remote node through computer to remote computer communication software. Users at their institutions can participate in a number of network functions involving other remote computer facilities. Data and graphics files can be transferred between network nodes. Program execution can be initiated from any of the network nodes (distributed processing). All of the nodes (excluding end nodes) have the capability for message routing, enabling the remote nodes to communicate with

each other as if a direct phone line existed between them, even though there may not be 'adjacent' nodes within the network.

Little scientific application software has been traded in the space science community, particularly because of its labor-intensive nature. In a network environment, such as SPAN, software trading is extremely easy and has been done extensively. The network also supports the transmission and reception of manuscripts. This significantly reduces the time it takes to perform correlative work when authors are located across the country.

Current funding for SPAN comes from two sources at NASA Headquarters: Code EI (funding the basic research and development of the system) and Code T (funding all SPAN communications). Code T and MSFC are instituting a new NASA communication highway called the PSCN (Program Support Communications Network). Much like the GSFC NASCOM system for realtime data flow, SPAN will use the PSCN for all future communication requirements starting in late 1985. It has been projected that the present SPAN system will be providing science support using the NASA PSCN at least into the 1990's. PSCN will provide considerable enhancement and flexibility in the types of communications needed for SPAN in the upcoming years. A modest growth for SPAN of 100% has also been projected over this time period.

SPAN will continue to be used as a testbed between space science investigators with the intent of exploring and employing modern computer and communication technology as a tool for doing space science research. This can be accomplished since SPAN is not a project-dependent system that requires a static hardware and software configuration for the duration of a mission.

With the addition of new nodes come more and diverse data bases, more NASA facilities, more distributed computing power, and more scientific expertise. Within the next few years, new developments in software and hardware will be implemented on SPAN that will greatly aid space science research. What would have taken weeks or months to accomplish will be done in minutes. It is anticipated that SPAN will greatly improve its access to gateways into Europe and other locations throughout the world. SPAN might well soon become another of the essential tools needed for conducting effective space science research.

III. NODE MEMBERSHIP

Membership in the SPAN network is open to all interested space science groups who have sufficient computer resources to allow a link to be established. The following guidelines outline the procedures to follow to apply for node membership and what is expected of each node.

A. SPAN Node Application

Written proposals should be sent to Dr. James L. Green, NASA/MSFC, Code ES53, Huntsville, Alabama, 35812. (Special note: limited funding is available for hardware and software requests.) The proposal should address the following questions:

1. Why do you wish to become a node on the network: what are your goals. For example, this could include scientific research, networking or communications testing, and the standardization of space science data and graphics.
2. What facilities and capabilities do you wish to link into the network and describe how this will be accomplished.
3. Are there any facilities at your node that would be available to remote users. If so, outline what procedures you require for remote users to gain access to your facilities.
4. What are your projected timelines for accomplishment of network connections.
5. Do you foresee a long-term involvement in SPAN.

Proposals will be reviewed by the DSUWG steering committee with a formal presentation made to the full DSUWG. Once on SPAN it is expected that a representative from your node will participate in the activities of the DSUWG.

B. MINIMUM HARDWARE ENTRANCE REQUIREMENTS

SPAN not only provides communication for cooperative space science activities, SPAN is also a testbed for network communications. Innovative network communications that are proposed to be used over SPAN are encouraged. Currently, the organizations who wish to become fully functional nodes quickly will need a system composed of Digital Equipment Corporation (DEC) hardware and software. Fully functional nodes currently include any DEC processor and operating system capable of supporting an appropriate version of the DECnet software package along with a correctly configured communications port. The networking protocol used on such systems is DECnet.

SPAN is currently working with organizations who wish to become network nodes

but do not have equipment capable of supporting DECnet. These sites include non-DEC computer systems as well as DEC computers executing the UNIX operating system. Partially functional nodes have been proposed for these sites and experimental network testing has begun.

C. MINIMUM NODE MANAGEMENT REQUIREMENTS

In order to ensure that the network functions smoothly, it is necessary that SPAN nodes conform to a small number of node management requirements. These requirements fall into two broad categories: network functionality and network security.

1. Functionality

a. Every node must designate a system manager that is capable of and directed to respond to the network manager's requests for information, applying updates to the DECnet data base and being responsible for node security.

b. Every node must provide information on its network users. Every node should have in its DECnet default account a file named USERLIST.LIS that contains the following information on every SPAN user as a minimum: the user's name ("Joe Smith"), his account ("SMITH"), and his default account "SYS\$SYSDEVICE:[SMITH]." (UIC and "Charge Account" information are desired but are not required.) This user list should be updated to reflect the current user population every month. This information is used by network users to locate and contact other users on the network.

c. Every node should provide information on its facilities. A file named NODEINFO.LIS should exist in the node's DECnet default account which includes the following information: The name, phone number, postal service mail address, and package delivery address of the system manager; the physical location of the computer/terminal and the modem; a phone number for the computer/terminal room; and a short description of the node's hardware, software, and special facilities. This information is needed to allow other system managers to know what areas of expertise exist at various nodes and to inform network users of available facilities. Use of local resources are at the discretion of local management.

d. Every node should keep their DECnet data base up to current SPAN revision levels. This is to keep the entire network functioning correctly.

e. Every node should keep its relevant operating system and networking software up to the manufacturer's current revision level (VAX/VMS, RSX-11M, IAS, DECnet, etc.).

2. Security

a. Every node should lock its DECnet default account to keep it from being logged onto interactively (VAX/VMS). If it cannot be locked from interactive use, the password should be given only to other SPAN system managers for inclusion in their DECnet data bases (RSX, IAS).

b. The node system manager should make a conscientious effort to eliminate trivial passwords on local user accounts. As many as possible of the security guidelines listed in Chapter IV, Section B should be used.

D. ACKNOWLEDGEMENTS

All scientific and technical manuscripts whose preparation is aided by use of the network and the facilities on the network should include an appropriate acknowledgement. The following is an example of a typical acknowledgement from a recent scientific paper.

"The authors would like to express their gratitude to the Data System Technology Program (DSTP) and the Space Physics Analysis Network (SPAN) pilot project for use of computing and networking facilities."

The continued funding of special network facilities and SPAN communications depends largely on justifying the use of the system. Thus, it is essential that the SPAN be acknowledged when appropriate. A simple rule for SPAN users to follow is that if SPAN is used and acknowledged the node will remain connected to the network. For the healthy continuation of SPAN, its usefulness must be continuously documented.

Please send a notification of acknowledgement for SPAN usage to SSL::GREEN. It is not necessary to send a paper or manuscript. Notification of acknowledgement for use of remote node facilities should be arranged between the parties involved.

IV. SECURITY AND CONDUCT ON THE NETWORK

A. Rules of the Road

SPAN users must realize that others are on the network. They should retain the same standards of courtesy that they use in dealing with others at their home institution. Just as it is considered to be unacceptable for a person to walk into an office or laboratory and pry into file cabinets, so it is unacceptable for someone to pry through another network user's disk files. Also, anytime a researcher allows another person to use his data, analysis software, special facilities, etc., the user should include an acknowledgement in any resulting papers thanking the original researcher. Any papers published where the author uses SPAN for gathering data, sharing data, electronic mail, conference calls, etc. should include a SPAN acknowledgement at the end of the paper. Some specific guidelines for use of a researcher's data and analysis programs are:

1. Always have the expressed consent (written is best) of the data provider before accessing files containing data or software. This means having a detailed understanding between the user and the provider of the bounds or limits of which data can be accessed. An O.K. to look at one orbit's worth of data does not give full rights to look at any other orbit. Also, the "provider" should be the PI of the instrument and not just someone else who has access to the data. However, the PI can delegate this control to others.
2. The provider must be notified of the uses of the data or software borrowed. The provider should be notified at the earliest possible time should new results come from the use of the data or software and mutually agreed upon terms should be obtained which clearly lay out the roles of the provider and user in further research efforts. This will result both in the appropriate acknowledgement of the provider (either in the acknowledgements or as a co-author of the publication) and in the correct use of the data.
3. In cases where data or software are used in a publication, submitting a copy of the paper to the provider prior to submission is highly desirable. The provider will then have an opportunity to see that the data or software are not misused.
4. No data or software obtained from another user should ever be distributed to anyone else without the express consent of the provider. This includes the user showing fellow collaborators plots or other results unless the provider is aware of the other researcher's involvement and agreement by the other researcher to observe the proprietary rights to the data.

A user should not assume that adding the provider's name to the list of co-authors of a paper or abstract will be a substitute for obtaining the proper set of agreements with the provider. A person may be just as upset by being an unwilling co-author as by being left off the author list.

B. Network Security

SPAN membership entails certain responsibilities. One of these responsibilities is to take reasonable local computer system security precautions. If a system is not hooked to anything but several local terminals, then the need for security precautions is low. But when a machine is attached to a wide area network (such as SPAN) and/or has one or more dialup terminal ports, then it becomes necessary for the system management to see that reasonable security precautions are taken. This is to insure that:

1. the system will not easily allow unauthorized users access to files and accounts on the local system, and
2. that the local system will not allow unauthorized users to access the network.

It is not necessary for the system management to "lock up" the system and make it difficult for users to access, but it is necessary that security be taken seriously by all users (especially system managers).

The following is a list of security guidelines that should be considered to be a minimal set of security precautions. Most are specific to VAX/VMS systems, but many also have relevance to RSX systems. Nearly all are simple, common sense measures that will go far in ensuring local and network security.

Local User Accounts

Accounts should be assigned to users on a one account/one user basis. This is to emphasize user responsibility and accountability. If a group of people need to work on each other's files, they should all be placed in the same UIC user group so group UIC protection can be utilized. Where it is necessary to have multiple user accounts, care should be taken as to who is allowed to know the password and use it. Passwords for multiuser accounts become public knowledge quite quickly if precautions are not taken. A single individual should be assigned the task of being responsible for an account's password. Any user needing to know the password to such an account should get the password from that person and not another user. This method will ensure that at least one person will know all the users who have legitimate access to a multiuser account. There should be at least a semiannual review of all user accounts. Accounts that are assigned to users that have left or are no longer being used should be removed from the system.

Password Protection

Probably the single most important measure a system manager can implement is to be sure that there are no trivial passwords in use on his system. Passwords should NOT be the user's first name, the same name as used for the

account, or a simple carriage return. Passwords should be at least eight characters in length and should use special characters, i.e., the dollar sign and underscore (VAX/VMS). Users should not make their passwords known to other users. If a user needs to access something from a different account, the files needed should be set to world or group read access. Users should change their passwords at least once every several weeks. If the system manager finds that a user refuses to keep a password on his account, he should lock a nontrivial password on the account. Newly created accounts should not be given trivial passwords such as a user's first name. Newly created accounts should be given an adequate password and the users should be told to change the password to something new on their first use of the account.

Authorization Flags

VAX/VMS managers have a number of account flags that can be set in the system authorization file (SYSUAF.DAT). These flags are set by the use of the Authorize Utility. First, flags which should be on all newly created accounts should be set on the default account record in SYSUAF.DAT. One flag that should be default on all user accounts is the DISDIALUP flag (for both primary and secondary days). All accounts should be created with this flag and it should be removed only if the user has a need for logging onto the system over dialup ports. (This method will not work on systems which use Gandalf PBX's to attach terminals to terminal ports.) System accounts on a VAX/VMS system should have the DISDIALUP and DISNETWORK flags set to force privileged use of the system to be done locally. System accounts which are not used on a regular basis should be DISUSERed to make interactive log-in impossible (i.e., SYSTEST).

DECnet Default Accounts

The DECnet default account in use on nearly all SPAN nodes is a security problem. Default accounts on VAX/VMS systems should have the following authorization flags set: DISDIALUP, DISNETWORK (both primary and secondary days), DISUSER, LOCKPWD, CAPTIVE, and DISCTLY. The default account should never be used for interactive use. It has been found that privileged DECnet default accounts are of little use and are a large security problem. Most nodes will find that removing this account from the system will not inconvenience the system or network manager. Default account protection on RSX systems is more of a problem due to the lack of the sophisticated controls available in VAX/VMS. The best way to keep the default account from being compromised is to make the password something other than "net" or "decnet" and allow the password to be known only to other system managers on the network for use in their DECnet data bases. AGAIN, DECNET DEFAULT ACCOUNTS SHOULD NEVER SEE INTERACTIVE USE.

File Security

DECnet makes remote file access and manipulation very easy and transparent. This can cause very large security problems. The system manager on a SPAN node should set his system-wide default protection to be NO world read, write, execute, and delete. It must be kept in mind that on a large network, "world" includes ALL users on ALL machines. If a user wants to allow the world read, execute access to all of his files, he can so specify in his log-in command file. Otherwise he can set individual files to world access so they can be copied or used from over the network. The system manager should insure that all important system files are set to allow nothing more than world read and execute. Files such as SYSUAF.DAT and NETUAF.DAT should be accessible only to the system manager.

Other Measures

Some other things that should be done to ensure local security include:

1. Never leave any SYSUAF.LIS files in SYS\$SYSTEM (VAX/VMS).
2. Accounting should be turned on and the system manager should inspect the output every month for unusual activity such as use of dialup ports and remote network log-ins during nonworking hours. System managers should inspect their system console printout frequently.
3. System privileged accounts should be used by only the system manager. Privileges which allow a user total control of a machine should be withheld from users (SYSPRV, BYPASS, CMKRNL, DETACH, etc. for VAX/VMS systems).

V. SPECIAL NODES

This section describes several special SPAN nodes. These nodes provide a unique service to the space science community. It is anticipated that as the network grows the importance of these NASA facilities to the science community will increase tremendously.

The National Space Science Data Center (NSSDC) Node

A. Introduction

NSSDC is NASA's primary facility for the long-term archiving and dissemination of spaceflight data. NSSDC offers to other SPAN nodes a number of on-line services to facilitate access to data and to information about online and offline data held at NSSDC and elsewhere. A number of these services are in the early development phase. Specifically, NSSDC offers online:

1. accessibility of selected sensor data;
2. accessibility of directory/catalog information on the location, access procedures, and other characteristics of data held online and offline;
3. requesting of data held offline at NSSDC;
4. finding of persons' SPAN node address, mailing address, and telephone number; and
5. information about the hardware/software configuration and other characteristics of various SPAN nodes.

A brief description of the current services is kept in the NSSDC DECnet default directory, and can be read using the following command:

```
$type NSSDC::SERVICES
```

Online access to these menu-driven services, including documentation, may be obtained by logging-on to the NSSDC node using account NSSDC (password not required) using the following commands:

```
set host NSSDC username: NSSDC
```

Several of these services have individual accounts whos names and passwords can be obtained upon request from NSSDC; mail such requests to NSSDC::NSSDC

B. Online Data Accessibility

The first NSSDC data set to be brought to an online accessibility status is the hourly resolution interplanetary magnetic field and plasma compilation. This data set comes from the 1963-1982 "omnitape" which has been used in the generation of the Interplanetary Medium Data Books and Supplements at NSSDC. The portion of this data set beginning January 1, 1976, is in file:

```
NSSDC::SYS$USR3:[OMNI.DATA]OMNI.DAT
```

This file will be extended into 1984 during 1985. The format for each record is the same as the "omnitape," and is given in file:

```
NSSDC::SYS$USR3:[OMNI.DOCUMENTS]OMNI.FORMAT.LIS
```

A subroutine to read the records, starting at any user-specified record and then proceeding sequentially, is in file:

```
NSSDC::SYS$USR3:[OMNI.PROGRAMS]RDOMNI.FOR
```

Additional routines for listing parameters from the data file are in the library:

```
NSSDC::SYS$USR3:[OMNI.PROGRAMS]
```

The menu-driven access to this data and information is the response to selecting option 5 from the menu presented upon signing on to the NSSDC account on the NSSDC node.

The first CDAW data base to be brought online on the SPAN network will be CDAW-8, which will focus on intervals of ISEE-3 deep-magnetotail passage. Availability is expected in mid-1985. This will be accessible by selecting option 2 from the NSSDC account on the NSSDC node.

Additional data files will be brought to an online status as resources and demand warrant. NSSDC anticipates working closely with DSI/WG in prioritizing data sets for such promotions.

C. NSSDC Online Data Catalog System (NODCS)

The NODCS consists of a high level directory (Central Online Data Directory - CODD) in which is held information about data sets in their entirety, and more detailed catalogs about data set granules (individual files, time increments, images, etc.). The system is expected to span the full spectrum of space and Earth sciences, although most work to date has concentrated on the directory for solar-terrestrial data.

A prototype version of the directory is available on the NSSDC VAX; the system uses the Oracle DBMS (Data Base Management System) (see Smith et al. [8]). The evolving menu-based user interface can be invoked by selecting option 3 from the menu displayed under the NSSDC account on the NSSDC node. As of December 1984, no discipline query capability is available, although such is planned for 1985. There is a scientific steering committee guiding NSSDC in the NODCS definition and development activities. However, feedback

from any member of the SPAN community would be carefully considered and highly appreciated.

As an interim approach to communicating to the SPAN community information on the NSSDC offline data archive, the file

```
NSSDC::SYS$USR3:[NSSDC.CAT]AIM.LIS
```

was created as a series of 80 character records. Each record identifies one NSSDC data set, and contains spacecraft name, Principal Investigator last name, 33-char. data set name, time span, form (e.g., mag tapes microfiche, etc.), and quantity of the data set. The VMS utility SEARCH may be used to select and list out records. For example:

```
SEARCH NSSDC::SYS$USR3:[NSSDC.CAT]AIM.LIS ISEE-3
```

would result in a listing of all NSSDC held data sets from ISEE-3. Only data sets obtained from solar-terrestrial and heliospheric missions launched since 1970 are included in this file at present. This information is also available as option 4 from the menu presented on the NSSDC account on the NSSDC node.

Online Ordering of NSSDC Held Offline Data Sets The account NSSDC on the NSSDC node can be used for incoming mail not intended for a person with his own account. Persons wishing to request data from NSSDC may use the VMS MAIL utility and SEND a message to NSSDC::NSSDC. This mailbox will be scanned daily. Requests should be specific as possible, and should include a return U.S. mail address. Requests may also be submitted by selecting menu option 6 under the NSSDC account and inserting information requested using a VMS editor. On exiting the editor the request will be automatically mailed to the correct account.

D. SPAN Node Address Query System

This service, available as menu option 7 under the NSSDC account on the NSSDC node, was established to enable SPAN users to determine the SPAN address, mailing address, and telephone address of other persons on the SPAN network. As the information available depends on the active support of the SPAN community, a function has been added to allow users to submit information to be included in the data base after review by NSSDC personnel. It also permits review or submission of data to the SPAN node hardware/software inventory described below.

E. SPAN Node Hardware/Software Inventory

NSSDC has recently performed a survey to ascertain what equipment and software packages are in use at various SPAN nodes. The results of this survey are available in file:

```
NSSDC::SYS$USR3:[NSSDC]SURVEY.MEM
```

It is intended that this file will be kept as current as information inflow

to NSSDC permits. Please use option 7 under the NSSDC account on the NSSDC node to submit information for this table.

The Data System Technology Program (DSTP) Node

The NASA Data System Technology Program (DSTP, formally called the NASA's End-to-End Data System or NEEDS) will be developing concepts and demonstrating technology over the next few years that will significantly reduce the time it takes for large amounts of acquired spacecraft data to be available to the experimenter (NEEDS System Team [9]). The DSTP development is supported by the Office of Aeronautics and Space Technology (Code R) at NASA Headquarters. The DSTP system is being constructed at MSFC and is currently the central node of the SPAN system (node name has remained NEEDS). The DSTP is made up of two closely linked systems: a Data Base Management System (DBMS) and a Mass Memory Assembly (MMA), both of which are undergoing software and hardware integration.

The DSTP/DBMS consists of several large mini-computers (three VAX 11/780's, a PDP 11/34, and a SEL) linked together by a high speed fiber optics bus with powerful data base management software to handle large quantities of data (see Thomas [1] for a system overview). The role of the DSTP/MMA is to store large multi-mission science and engineering data bases in a large permanent archive using optical disk media. The MMA will have the storage capacity of 10^{13} bits on 125 optical disks. The MMA is designed to archive data packet input at rates up to 50 megabits/second. Plans are underway that will allow the archiving of Spacelab data with this system in near-real time in the 1986 timeframe.

The NEEDS node on SPAN, which is part of the DSTP, uses the Packet Management Software (PMS) developed at GSFC and ORACLE (a commercial relational data base management language) for user access to the MMA.

It is anticipated that the DSTP NEEDS node will be released for general use by SPAN users by the end of 1985.

Mission Integration and Planning System (MIPS) Node

The MIPS node is located at MSFC. MIPS is responsible for nearly all the timing of shuttle-attached payloads such as Spacelab. Investigator inputs into the MIPS include: experiment functional objectives, physical size and pointing information, and other similar payload information required for mission implementation. It is expected that the addition of MIPS on SPAN will enhance pre-mission planning, provide shorter turnaround, improve communication between users and planners, save manpower in the long run, and start the automation of the Spacelab mission planning process at the investigation level.

MIPS also provides information by means of the mission timeline regarding when other experiments are operating and in what mode. This information is

essential to know when one experiment affects the environment that another experiment is measuring. Complete and up-to-date timeline information will be essential for many of the science-dedicated missions, such as Space Plasma Laboratory.

Initial use of MIPS allows normal POCC interface files to be accessible to users. Users have been routinely supplying mission planning information through SPAN to MIPS on request. Outside access to MIPS through SPAN will be restricted during POCC simulations or during a mission. Arrangements are currently being made to accommodate specific user requests. When it has been determined that remote access does not affect MIPS operation, remote users will be allowed access to MIPS during a mission. As MIPS becomes more sophisticated in its mission planning capabilities, it will allow remote users to query the POCC data base and execute orbiter orbit and attitude, and TDRSS tracking programs. Therefore, the remote access and use of MIPS by Spacelab investigators is designed in an evolutionary approach increasing the investigators' capabilities at each step. It is necessary to do this since the MIPS system was not originally designed to be interrogated extensively by Spacelab/SPAN users.

APPENDIX A - DSUWG MEMBERSHIP

The chairman for the DSUWG is Dan Baker (LANL). The SPAN project scientist and manager is James Green (MSFC) and David Peters (MSFC/INTERGRAPH) is the network manager. The following is a list of the current DSUWG members in each subgroup.

POLICY SUBGROUP

Chairman		
Dr. Ron Zwickl	LANL	505-667-3897
Members		
Dr. Vincent Abreu	U of Michigan	313-763-6217
Prof. Pat Reiff	RICE UNIV	713-527-4944
Dr. Richard McEntire	APL/JHU	301-953-7100
Dr. Ray Walker	UCLA	213-825-7685
Dr. Eugene Greenstadt	TRW	213-536-2016
Dr. Bob Theis	GSFC	301-344-7576
Dr. Dave Klumpar	UTD	214-690-2835
Dr. Stan Shawhan	NASA HQ	301-453-1676
Dr. Mike Wiskerchen	Stanford	415-497-2848
Dr. Bob McPherron	UCLA	213-825-1882
Dr. Dan Baker	LANL	505-667-3101
Mr. David Peters	MSFC/INTERGRAPH	205-453-4625

SOFTWARE AND GRAPHICS STANDARDS SUBGROUP

Chairman		
Dr. Dennis Gallagher	NASA/MSFC	205-453-0818
Co-Chairman		
Dr. Bill Peterson	Lockheed	415-858-4069
Members		
Dr. Joe Douppnik	USU	801-750-2982
Dr. Don Sawyer	NSSDC	301-344-8145
Dr. Bill Taylor	TRW	213-536-2015
Dr. Doug Menietti	SwRI	512-684-5111
Ms. Lora L. Suther	APL/JHU	301-953-7100
Dr. Howard Singer	AFGL	617-861-5757
Dr. Thomas Moore	NASA/MSFC	205-453-0028
Dr. Roy Torbert	UCSD	714-452-3315
Dr. Barry Mauk	APL/JHU	301-953-7100
Dr. Carl McIlwain	UCSD	714-452-3314
Mr. Ron Janetzke	SwRI	512-684-5111
Dr. Joe Bredekamp	GSFC	301-344-8451
Dr. Robin Coley	UTD	214-690-2853

NETWORKING AND HARDWARE SUBGROUP

Chairman		
Dr. Jim Green	NASA/MSFC	205-453-0028
Co-Chairman		
Dr. Rob Gold	APL/JHU	301-953-7100
Members		
Dr. Neal Cline	UCLA	213-825-3506
Dr. Jim Willet	JPL	213-354-5396
Dr. Hunter Waite	NASA/MSFC	205-453-3037
Dr. Douglas Potter	U OF WASHINGTON	206-543-9055
Mr. Gordon Lentz	U OF CHICAGO	312-962-7836
Mr. John Piotrowski	JPL	818-354-5491
Dr. Calvin Teague	Stanford	415-497-3596
Mr. Dick des Jardins	CTA	303-740-7026
Dr. Fred Wulff	NASA HQ	301-755-2430
Mr. Bob Stevens	NASA HQ	301-755-2430
Mr. Dennis Roth	NSSDC	301-344-6818

DATA BASE STANDARDS SUBGROUP

Chairman		
Dr. Joe King	NSSDC	301-344-7355
Members		
Ms. Pat Astill	NSSDC	301-344-6818
Dr. Bob Clauer	Stanford	415-497-4691
Dr. Randy Davis	U OF COLO	303-492-6867
Dr. Richard Munro	HAO	303-494-5151
Dr. Jim Slavin	JPL	213-345-2881
Mr. Bob Power	UTD	214-690-2852
Dr. Paul Smith	GSFC	301-344-5876

APPENDIX B - SPAN PRIMER

Introduction

The purpose of the SPAN is to support communications between users on network nodes. This includes data access and exchange, electronic mail communication, and sharing of resources among members of the space science community (see Green et al. [2]).

Communication between nodes on the SPAN is accomplished by means of DECNET software. DECNET software creates and maintains logical links between network nodes with different or similar operating systems. The operating systems currently in use on SPAN are VAX/VMS, RSX, and IAS. DECNET provides network control, automatic routing of messages, and a user interface to the network. The DECNET user interface provides commonly needed functions for both terminal users and programs. The purpose of this appendix is to provide a guide on the specific implementation of DECNET on SPAN and is not intended to replace the extensive manuals on DECNET already produced by DEC.

DECNET supports the following functions for network users:

1. TASK-TO-TASK COMMUNICATIONS: User tasks can exchange data over a network logical link. The communicating tasks can be on the same or different nodes. Task-to-task communication can be used to initiate and control tasks on remote nodes.

2. REMOTE FILE ACCESS: Users can access files on remote nodes at a terminal or within a program. At a terminal, users can transfer files between nodes, display files and directories from remote nodes, and submit files containing commands for execution at a remote node. Inside a program, users can read and write files residing at a remote node.

3. TERMINAL COMMUNICATIONS: RSX and IAS users can send messages to terminals on remote RSX or IAS nodes. This capability is available on VMS nodes by using the PHONE utility.

4. MAIL FACILITY: VMS users can send mail messages to accounts on remote VMS nodes. This capability is currently available for RSX and IAS nodes but is not supported by DEC. There are slight variations for RSX and IAS network mail compared to VMS mail.

5. REMOTE HOST: VMS, RSX, and IAS users can log-on to a remote host as if their terminal were local.

Network Implementations

The SPAN includes implementations for RSX, IAS and VAX/VMS operating systems. DECNET software exists at all the SPAN nodes and it allows for the communication of data and messages between any of the nodes. Each of the network nodes has a version of DECNET that is compatible with the operating system of

that node. These versions of DECNET have been presently developed to different extents causing some nodes to have more or less capabilities than other nodes. The version or "phase" of the DECNET, as it is called, indicates the capability of that node to perform certain levels of communication. Since RSX and IAS implementations are almost identical, they are described together.

Users need not have any special privileges (VAX/VMS users will need NETMBX privileges on their account) to run network tasks or create programs which access the network. However users must supply valid access control information to be able to use resources. The term "access control" refers to the user name and password of an account (local or on a remote node).

Online system documentation is a particularly important and valuable component of DEC systems. At the present, SPAN is comprised almost completely of DEC systems. An extensive set of system help files and libraries exist on all the SPAN DEC nodes. The HELP command invokes the HELP utility to display information about a particular topic. The HELP utility retrieves help available in the system help files or in any help library that you specify. You can also specify a set of default help libraries for HELP to search in addition to these libraries.

Format: HELP [keyword [...]]

On many systems new users can display a tutorial explanation of HELP by typing TUTORIAL in response to the "HELP Subtopic?" prompt and pressing the RETURN key.

UTILITIES FOR DECNET-VAX

VAX terminal users have several utility programs for network communications available from the VMS operating system. Documentation for most of these utilities can be found in the Utility Reference Manual of the VAX/VMS manual set and each utility has extensive online help available. The following descriptions are a brief introduction to these utilities:

MAIL: The VAX/VMS mail utility allows you to send a message to any account or to a series of accounts on the network. To send a message, you must know the account name of the person you wish to contact and his node name or node number. (This will be covered more extensively in the section Utilities for all DEC SPAN nodes.)

FINGER: The DECUS VAX/VMS Finger utility has been installed on a number of SPAN VAX/VMS systems. (Ask your system manager as to its availability.) Finger allows a user to see who is doing what both on his machine and on other machines on the network that support Finger. Finger also allows a user to find information on the location and accounts used by other users, both locally and on the network. If your VAX supports VMS Finger, further information can be found by typing HELP FINGER.

PHONE: The VAX/VMS PHONE utility allows you to have an interactive conversation with any other current user on the network. This utility can only be used on video terminals which support direct cursor positioning. The local system manager should know if your terminal can support this utility. To initiate a phone call, enter the DCL command PHONE. This should clear the screen and set up the phone screen format. The following commands can be executed:

DIAL nodename::username

Placing a call to another user. You must wait for a response from that user to continue. DIAL is the default command if just nodename::username is entered.

ANSWER Answers the phone when you receive a call.

HANGUP Ends the conversation (you could also enter a CTRL/Z).

REJECT Rejects the phone call that has been received.

DIR nodename:: Displays a list of all current users. This command is extremely useful to list current users on other nodes of the network.

FACSIMILE filename Will send the specified file to your listener as part of your conversation.

To execute any of these commands during a conversation, the switch hook character must be enter first. By default, that character is the percent key.

DCL commands will act transparently over the network. For example, to copy a file from a remote node:

```
$copy
From: "username password"node::disk:[directory]file.lis
To: newfile.lis
```

This will copy "file.lis" in "directory" on "node" to the account the command was issued in and name it "newfile.lis". The access information (user name and password of the remote account) is enclosed in quotes. Note that you can also copy that same file to any other node and account you desire. As another example, to get a directory listing from a remote node use the following command:

```
$dir node::[directory] (if on the default disk)
```

UTILITIES FOR DECNET-11M/DECNET-IAS

There are certain DECNET functions that can only be done on nodes that have

the same type of operating systems such as the SSL, TRW, SPRL, and UTD nodes both with an RSX-11M operating system. The capabilities offered to the RSX DECNET user can be broken down into two major categories: those functions for terminal users and those functions for FORTRAN programmers.

DECNET-11M terminal users have several utility programs available to them which allows logging onto other machines in the network, file transfers, message communication, and network status information.

REMOTE-LOGON: The REMOTE-LOGON procedure allows a user at a node to log-on to another node in the network. This capability is also called virtual terminal. RVT is the host to terminal program which allows the user to log-on to adjacent nodes in the network from a DECNET-11M node. This program is initiated by typing "RVT" and answering the HOST question with the network node name. The "SET HOST" command on the SPAN-VAX also allows you to log-on to adjacent nodes. Both programs can be used as in the following example. To log-on to the UTD node the following procedure is needed:

Use RVT to log-on to say the NEEDS VAX (>RVT NEEDS).

On the VAX type "SET HOST" (note; UTD can be reach directly with a >RVT UTD response).

Enter the node name; "UTD"

At this point you will see the MCR prompt >

Log-on to that node.

When finished type "BYE" (to leave MCR)

To log-off the Vax type "LOGOUT"

The use of RVT should be limited since it requires many resources on a PDP.

NETWORK FILE TRANSFER: NFT is the Network File Transfer program and is part of the DECNET software. It is invoked by typing NFT <CR> to file = from file or by typing NFT to file = from file. Embedded in the file names must be the node name, access information, and directory if it is different than the default conventions. The following structure for the file names must be used when talking to the NEEDS node with NFT.

NODE/username/password::Dev:[dir.sub-dir]file.type

where, Dev is either DRA0: or DRA1: (or other drive designations).

The following NFT switches are very useful:

- /LI Directory listing switch.
- /AP Appends/adds files to end of existing file.
- /DE Deletes one or more files.
- /EX Executes command file stored on remote/local node.
- /SB Submits command file for execution (remote/local).
- /SP Spools files to line printer (works only with "like" nodes)

A particular use for NFT is for the display of graphics files on the network (Gallagher et al. [10]). It is important to note, however, that some device dependent graphics files are not all displayable such as those generated by IGL software. The graphics files generated by the MSSL graphics package are displayable when residing at other nodes by using the following input:

```
NFT> TI:=SPAN/NET/NET::[NETNET.RIMS]D1364.COL
```

Graphics files generated by IGL can be displayed by running either REPLAY or NETREP programs (see the net-library documentation).

TERMINAL COMMUNICATIONS: TLK is the Terminal Communications Utility which allows users to exchange messages through their terminals. TLK resembles somewhat the RSX broadcast command but with more capabilities. TLK currently works only between RSX-11 nodes and within a RSX-11 node. There are two basic modes of operation for TLK: single message mode and the dialogue mode.

The single message mode conveys short messages to any terminal in the same node or remote node. The syntax for this operation is:

```
>TLK TARGETNODE::TTn:--Message--
```

The dialogue mode allows you to have a conversation with another network terminal user.

To initiate the dialogue mode type:

```
>TLK TARGETNODE::TTn<cr>
```

What will be printed out will be:

```
<TLK> - START OF DIALOGUE TLK>
```

When you receive the TLK> prompt, you can enter a new message line.

NETWORK CONTROL PROGRAM: NCP is the Network Control Program and is designed to primarily help the network manager. However, there are a number of NCP commands which can be of general use to the unprivileged user. With these commands the user can quickly determine node names and whether nodes are reachable or not. Help can be obtained by entering NCP>HELP and continuing from there. For a complete listing of all the NCP commands that are available to unprivileged users refer to the NCP appendix of the DECNET-11M

manual. The following is a partial listing of NCP commands that should be the most beneficial to users:

```
NCP> SHOW KNOWN NODES NCP> SHOW ACTIVE NODES
```

UTILITIES FOR ALL DEC SPAN NODES

One of the main objectives of the SPAN system project is to accommodate coordinated data analysis without leaving one's institution. Therefore there is a strong need to develop the ability to have graphic images of data from any node to be displayed by any other node. The current inability to display data on an arbitrary graphics device at any node has been quickly recognized. As general network utilities are developed to support the display of device dependent and independent graphic images, the handbook SPAN GRAPHICS DISPLAY UTILITIES HANDBOOK by Gallagher et al. [10] will serve to document their use and limitations. The graphics handbook is a practical guide to those common network facilities which will be used to support network correlative studies from the one-to-one to the workshop levels. For each graphics software utility the handbook contains information necessary to obtain, use, and implement the utility.

Mail

As briefly discussed earlier all SPAN DEC nodes have a network mail utility. Before sending a mail message, the node name and user name must be known. The next section will discuss the SPAN wide user name facility that aids in finding SPAN users. The node names are listed in Appendix D.

To send a message to the network manager, you would enter the following commands (user entered information is capitalized):

```
$ MAIL
mail> SEND
to: NEEDS::PETERS
subj: MAIL UTILITY TEST
```

Enter your message below. Press ctrl/z when complete ctrl/c to quit:

```
DAVE, OUR NETWORK CONNECTION IS NOW AVAILABLE AT ALL TIMES. WE ARE
LOOKING FORWARD TO WORKING FULL TIME ON THE SPAN. WE ARE ALSO SEARCHING FOR
A SCIENTIFIC ANALYSIS PACKAGE FOR OUR VAX. DO YOU KNOW OF ANY THAT MAY BE OF
USE TO US? THANKS FOR ALL YOUR HELP.
JOHN CTRL/Z
```

```
mail>EXIT
```

In order to send mail to more than one user list the desired network users on the same line as the TO: command separating each with a comma. Another way to accomplish this is to use a file of names. For example, in the file SEPAC.DIS, all SEPAC investigators on SPAN are listed:

NEEDS::ROBERTS
NEEDS::REASONER
NEEDS::GREEN
SWRI::JIM
TRW::TAYLOR
STAR::WILLIAMSON

The network mail utility will send duplicate messages to all those named in the above file by putting the file name on the TO: command line (TO: @SEPA).

A second option for the SEND command is to include a file name which contains the text to be sent. You will still be prompted for the TO: and SUBJ: information. The following statements give a brief description of other functions of the mail utility: READ n Will list, on the terminal, the mail message corresponding to number n. If n is not entered, any new mail messages will be listed.

FILE Saves a copy of the current message to a designated file.

FORWARD Sends a copy of the current message to other users.

REPLY Allows you to send a message to the sender of the current message.

DIR Lists all messages and their numbers that you have received. These numbers can then be used with the READ command.

Network User Lists

A list of users for any of the SPAN nodes has been implemented as a distributed system for which the node managers are responsible for. The following is a partial example of a userlist on node NEEDS. The complete list can be displayed or searched on over the network using standard operating system commands (for example; \$TYPE NEEDS::USERLIST).

Owner	User Name	UIC	Account	Default Directory
RICK CHAPPELL	CHAPPELL	[165,001] ES51	DRO:	[CHAPPELL]
JOHN CLARKE	CLARKE	[214,001] ES62	DRO:	[CLARKE]
PAUL CRAVEN	CRAVEN	[206,001] ES53	DRO:	[CRAVEN]
DBMS	DBMS	[100,001] DBMS	DRO:	[DBMS]
DOUG THOMAS	DOUG	[105,001] EB32	DRO:	[THOMAS]
BARBARA GILES	GILES	[153,001] ES53	DRO:	[GILES]
JIM GREEN	GREEN	[161,001] ES53	DRO:	[GREEN]
RICK HELMICK	HELMICK	[143,001] AN31	DRO:	[HELMICK]
JOE GALEY	JA51	[347,001] JA51	DRO:	[JA51]
MORAYMA LUIS	LUIS	[145,001] EL12	DRO:	[LUIS]
TOM MOORE	MOORE	[205,001] ES53	DRO:	[MOORE]

Owner	User Name	UIC	Account	Default Directory
PMS	PMSAPLIB	[075,001]	DBMS	DRO:[PMSAPLIB]
LINDA PORTER	PORTER	[221,001]	ES01	DRO:[PORTER]
DAVID REASONER	REASONER	[162,001]	ES53	DRO:[REASONER]
HUNTER WAITE	WAITE	[163,001]	ES53	DRO:[WAITE]

FACILITY LISTING OF NETWORK NODES

Much like the user list, a network-wide facility listing is available for each node in their network default account. The following example is for the APL node. Other node facility information can be obtained by typing NODE::NODEINFO.

APL

MAIN ADDRESS FOR MAIL AND PACKAGES

Lora Suther 2-150
 JHU APL
 Johns Hopkins Rd. Laurel, MD 20707

OFFICE PHONE (301) 953-5000 x8412

PHYSICAL LOCATION OF THE APL VAX

Building 2-46
 JHU APL
 Johns Hopkins Rd. Laurel, MD 20707

PHONE NUMBERS

Terminal room (301) 953-5000 x8415
 Computer room (301) 953-5701 (direct dial-in)

DESCRIPTION OF THE APL VAX

VAX 11/780 currently running VAX/VMS V3.5 with
 6 MB physical memory
 1 RPO7 disk drive
 1 TU78 6250/1600 tape drive
 4 Kennedy 1600/800 tape drives
 1 DMR-11
 2 DZ-11s
 1 RAMTEK 9400 color graphics system
 1 GOULD printer/plotter
 1 dial-up line

Software includes:
VAX-11 FORTRAN
DECnet
NCAR
Assorted CALCOMP compatible libraries.

APPENDIX C - DATA BASE MANAGEMENT

To be completed by June 1985.

APPENDIX D - KNOWN NODE SUMMARY AS OF FEBRUARY 21, 1985

INSTITUTION	NODE	(Address)	Machine
Applied Physics Laboratory	APL	1.35	VAX 11/780
Goddard Space Flight Center			
National Space Science Data Center	NSSDC	1.43	VAX 11/780
Code 960	PACF	1.40	VAX 11/780
Code 740	VX740	1.41	VAX 11/780
Code 690	LEPVAX	1.44	VAX 11/780
Code 690	SIRIS	1.42	VAX 11/730
Jet Propulsion Laboratory			
Planetary Pilot Data System	PPDS	5.1	VAX 11/780
Planetary Image Processing Facility	JPLIF	5.6	VAX 11/725
PPDS Management PR0350	JPLPRO	5.20	PRO 350
Lockheed Palo Alto Research Laboratory	LOCKHD	1.52	VAX 11/750
Los Alamos National Laboratory			
XNET Central Routing Node	XNET1	1.4	VAX 11/780
Earth Space Science Data Processing 2	ESSDP2	1.5	VAX 11/780
Earth Space Science Data Processing 1	ESSDP1	1.15	VAX 11/780
Marshall Space Flight Center			
Data System Technology Program	NEEDS	1.36	VAX 11/780
Space Science Laboratory	SSL	1.37	PDP 11/34
NEEDS DECnet Router Server	ROUTER	1.38	Comm. Server
Marshall Interactive Planning Sys.1	MIPS1	1.230	VAX 11/780
Marshall Interactive Planning Sys.4	MIPS4	1.231	VAX 11/780
Operations Testing System (SUNSTAR)	OMIS1	1.235	VAX 11/750
Southwest Research Institute	SWRI	1.62	VAX 11/750
Stanford University			
Stanford Telecommunications and Radio Science Laboratory	STAR	1.45	VAX 11/780
Second STAR System	STAR1	1.49	VAX 11/780
Science Payload Operation Control Cntr.	SPOCC	1.46	VAX 11/750
Spacelab Experiment VAX	VCAP	1.47	VAX 11/750
Stanford Solar Studies Group	CORONA	1.48	VAX 11/750
Stanford Spacelab Testbed PR0350	PRO1	1.67	PRO 350
Stanford Spacelab Testbed PR0350	PRO2	1.68	PRO 350
University of California Los Angeles	VXBMS	1.83	VAX 11/780
University of California San Diego			
La Jolla Space Physics 01	LJSP01	1.50	VAX 11/780
La Jolla Space Physics 02	LJSP02	1.51	PDP 11/70
University of Iowa	IOWA	1.64	VAX 11/780

University of Texas at Dallas
Utah State University

UTD	1.61	PDP 11/23+
USU	1.70	PDP 11/70

APPENDIX E - LIST OF ACRONYMS

AE - Atmospheric Explorer
 ATTCOM - AT and T Communications
 CDAW - Coordinated Data Analysis Workshop
 CDSF - Central Data Services Facility (branch of the NSSDC)
 CLASS VI- A class of extremely fast computers (Cray, Cyber)
 CODD - Central Online Data Directory
 DBMS - Data Base Management System
 DDCMP - DEC "level II" network protocol
 DDS - Digital Data Service
 DE - Dynamics Explorer
 DEC - Digital Equipment Corporation
 DECNET - DEC networking products generic family name
 DMA - Direct Memory Access
 DMR-11 - DEC UNIBUS computer DMA networking hardware
 DMSF - Data Management Systems Facility
 DMV-11 - DEC Q-BUS computer DMA networking hardware
 DSTP - Data Systems Technology Program (at MSFC)
 DSUWG - Data System Users Working Group
 GSFC - Goddard Space Flight Center
 IMP - Interplanetary Monitoring Platform
 ISEE - International Sun-Earth Explorer
 LANL - Los Alamos National Laboratory
 MFENET - Magnetic Fusion Energy Network
 MIPS1 - Mission Integration and Planning System #1 (MSFC)
 MMA - Mass Memory Assembly (connected to the DSTP)
 MSFC - Marshall Space Flight Center
 NEEDS - NASA's End-to-End Data System
 NODCS - NSSDC Online Data Catalog System
 NSSDC - National Space Science Data Center (at GSFC)
 PACF - Planetary Atmospheres Computing Facility (at GSFC)
 PCDS - Pilot Climate Data System
 PI - Principal Investigator
 PLDS - Pilot Land Data System
 PMS - Packet Management System
 POCC - Payload Operations Control Center
 PPDS - Planetary Pilot Data System
 PSCN - Program Support Communications Network
 SCAN - Space-plasma Computer Analysis Network (former name for SPAN)
 SPAN - Space Physics Analysis Network
 SSL - Space Science Laboratory (at MSFC)
 STARLAB - Stanford Telecommunications and Radio Science Laboratory
 TDRSS - Tracking and Data Relay Satellite System
 UIC - User Identification Code
 X.25 - A "level II" communication protocol for packet switch networks

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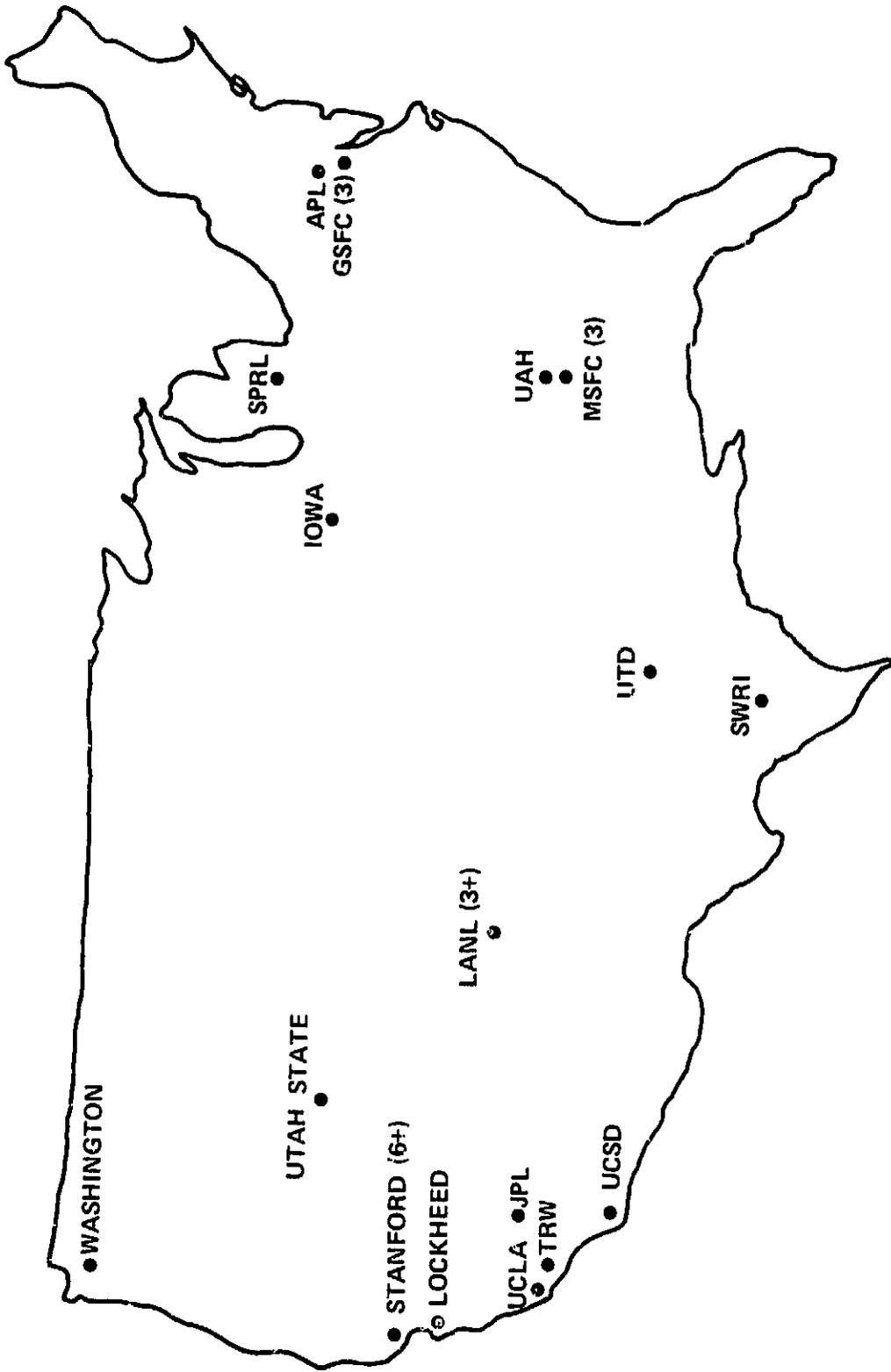


Figure 1. SPAN nodes as of November 1984.

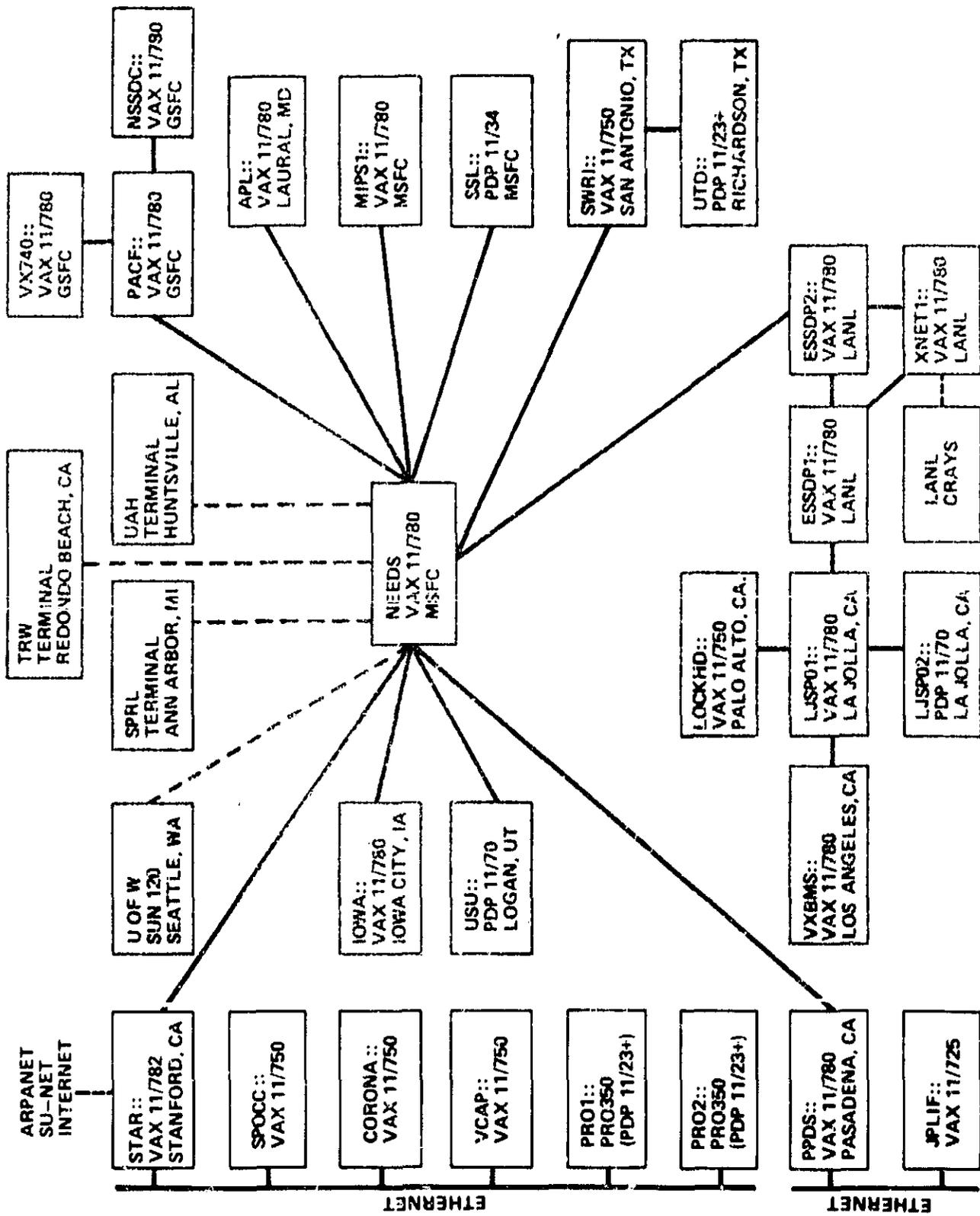


Figure 2. SPAN communication configuration as of November 1984.

APPROVAL

INTRODUCTION TO THE SPACE PHYSICS ANALYSIS NETWORK (SPAN)

By The Data Systems Users Working Group (DSUWG)

The information in this report has been reviewed for technical content. Review of any information concerning Department of Defense or nuclear energy activities or programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.



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