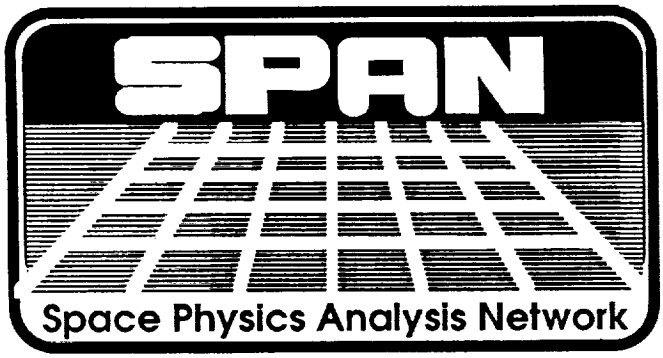

NSSDC/WDC-A-R&S 89-23

MANAGEMENT OF THE SPACE PHYSICS ANALYSIS NETWORK (SPAN)

James L. Green
Valerie L. Thomas
Todd F. Butler
David J. Peters
Patricia L. Sisson

January 1990

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Management of the Space Physics Analysis Network (SPAN)

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Approval Page

Management of the
Space Physics Analysis Network
(SPAN)

Third Edition

Ron Zwickl — 4/24/90

Dr. Ronald D. Zwickl, NOAA/SEL — Date
NSI Users Working Group Chairman

James L. Green — 4/24/90

Dr. James Green, NSSDC — Date
SPAN Project Scientist

David J. Peters — 24 April 1990

David J. Peters, NSSDC — Date
SPAN Project Manager

Preface

The intended audience for this publication is the SPAN community at large. The content of this document should be useful for computer site managers now participating in SPAN or planning to do so in the near future.

This document refers to the administrative issues specific to SPAN management; however, at times this document may assume that the reader is acquainted with the VAX/VMS operating system, DECnet networking terminology, and DCL, as well as other programming languages. A glossary of terms and acronyms is included in the appendix.

There are some sections of this document that are repeated in the *Introduction to the Space Physics Analysis Network (SPAN).* Any errors found in this docment should be reported to:

NCF::NETMGR
(301) 286-7251
FTS 888-7251

Contents

Acknowledgements

The members of the NSI Users Working Group who support the SPAN Management Team by providing their time to make the system successful are gratefully acknowledged. The Information Systems Office, especially Sandy Bates, and the Communication and Data Systems Division at NASA Headquarters are also acknowledged for their continued financial support for SPAN.

The following individuals are recognized for their time, thought, and effort in making outstanding contributions to the content of this manual.

Nick Van der Heijden
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Paris, France

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1. Introduction

The ultimate network for the space and earth sciences is envisioned as a considerable evolution and expansion over the current Space Physics Analysis Network (SPAN). SPAN and its management interact with remote investigators across the United States, Europe, Canada, and Japan, and with the National Aeronautics and Space Administration (NASA) and European Space Agency (ESA) projects and data centers. Interaction includes all the NASA discipline data system programs (Planetary Data System, NASA Ocean Data System, NASA Climate Data System, and Pilot Land Data System).

The purpose of SPAN is to provide a network for cooperative space and earth science research and correlative data analysis that is spaceflight-mission independent. The number of SPAN users will grow, along with the need for providing more and better access to NASA and ESA facilities. This increasing complexity will require greater management responsibilities to ensure adequate service to the SPAN community. The purpose of this document is to define necessary responsibilities of key SPAN management personnel and to provide a contact list for setting procedures into motion that will ensure the quick resolution of SPAN communications and policy problems.

It is imperative that SPAN be useful to the scientific users of the system. Therefore, while an important aspect of the SPAN program is to investigate new technologies and ideas for processing, storing, and transferring data from user to user, changes in the system should be directed toward improved usefulness and efficiency in network activities. In order to ensure that SPAN retains its usefulness to the scientific user community as the system grows and develops, the science users group named the NSI Users Working Group (NSIUWG) acts as the advisory committee to SPAN project management. The NSIUWG is the direct result of the merging of the previous SPAN Data System Users Working Group (DSUWG) and the NASA Science Network (NSN) User Working Group. Summary reports of past DSUWG and NSIUWG meetings can be found in *Eos*.

In late summer 1986, US-SPAN was reconfigured to make use of NASA's Program Support Communications Network (PSCN). The PSCN, contrary to what the name may imply, is not really a computer-to-computer network. It is more appropriate to visualize the PSCN as a group of telecommunications services provided to the NASA community. SPAN has benefitted greatly from the use of the PSCN circuit switch service and NASA Packet Switch System (NPSS) communication highways. SPAN's use of several different types of communication facilities greatly enhances its versatility but also complicates its management.

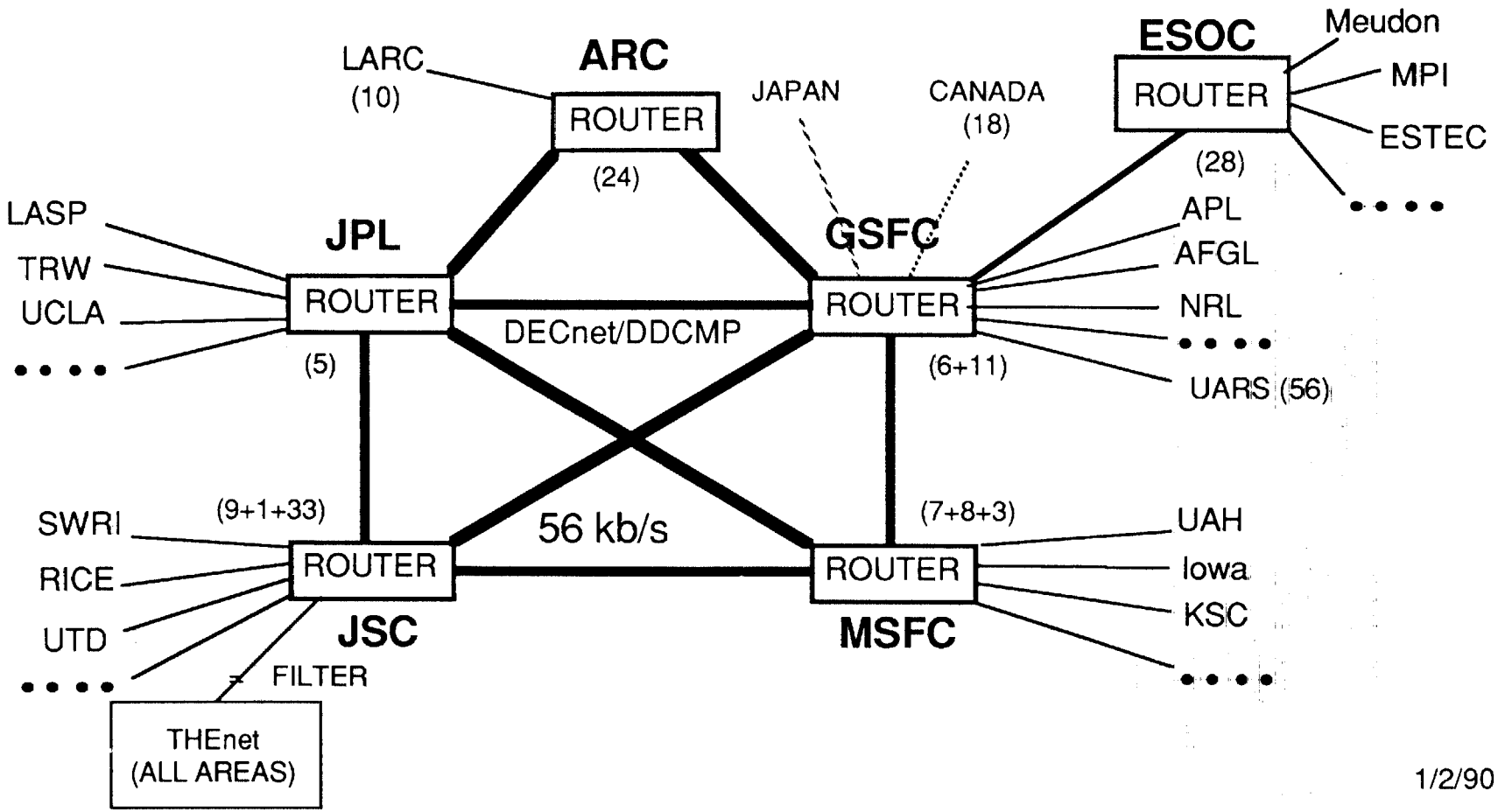

Figure 1. SPAN Backbone Configuration

The current SPAN topology (Figure 1) resulted from working closely with the PSCN contractor, Boeing Computer Support Services, and the Marshall Space Flight Center (MSFC) Communications Office (lead center for the PSCN). SPAN features six primary routing centers: Ames Research Center (ARC), Goddard Space Flight Center (GSFC), Johnson Space Center (JSC), the Jet Propulsion Laboratory (JPL), Marshall Space Flight Center (MSFC), and the European Space Operations Center (ESOC). Located at each routing center are one or more dedicated computer systems used for supporting network communication.

Each NASA routing center is connected to the others via 56 kilobit per second (kbps) dedicated circuits, forming the SPAN DECnet backbone. The ESOC to GSFC backbone link currently utilizes a 19.2 kbps terrestrial circuit. The tail circuits then complete the SPAN topology by connecting the various SPAN member institutions located in North America and Europe into the nearest routing center (ARC, GSFC, JPL, JSC, MSFC, or ESOC). These tail circuits, in almost all cases, are simple, dedicated, leased lines running at a minimum of 9.6 kbps. Some tail circuits, based on their traffic, have been upgraded to 56 kbps. In Europe, tail circuits are generally provided by X.25 Public Packet Switch Networks.

The SPAN use of the PSCN highway provides a reliable and fast network, which is reasonably transparent to the user. Because of the large size and structure of SPAN, considerable cooperation and interaction between managers at the remote nodes and routing centers must be clearly defined to continue to make SPAN a secure and highly successful tool for facilitating space and earth science research.

The purpose of this document is to define the operational management structure and to delineate the responsibilities of key SPAN individuals. The management structure must take into account the large NASA and ESA science research community by giving them a major voice in the operation of the system. Appropriate NASA and ESA interfaces must be provided so that there will be adequate communication facilities available when needed. Individual needs for security and cooperation by the member institutions on SPAN must also be addressed. The SPAN management structure, therefore, is consistently aligned with the organization of the NSIUWG, involving the responsible NASA and ESA SPAN routing centers and the remote institutions' computer and science managers.

2. Management Structure for SPAN

The SPAN management structure, shown schematically in Figure 2, partially follows the physical communication topology of the network. European counterparts for these positions also exist. When a problem arises, the responsibility for its resolution is handled locally (e.g., Europe, United States, Japan). However, in some cases the US-SPAN Management Team may need to intervene for a final determination.

The current list of the individuals responsible for SPAN management is contained in Appendix A. The responsibilities of each group and individual position are described below.

2.1 Advisory Committee

The following is a list of responsibilities for the advisory committee, which is comprised of the NSI Users Working Group (NSIUWG) and serves as a science and technical advisory committee for SPAN:

1. Recommends the general technical direction in which SPAN will evolve.

2. Periodically meets with the Project Scientist, Project Manager, and Network Operations Manager to review the performance of the network and analyze network user problems, and then recommends possible solutions.

3. Reviews network security and recommends changes based on maintaining an appropriate level of security for all SPAN nodes. In addition, the NSIUWG periodically reviews the current policy with respect to violations of network security. The policy is enforced by the Network Operations Manager and Routing Center Managers.

4. Annually reviews the four primary SPAN manuals:

   - *Introduction to the Space Physics Analysis Network (SPAN)*
   - *Management of the Space Physics Analysis Network (SPAN)*
   - *SPAN Security Policies and Guidelines*
   - *The Space Physics Analysis Network Node Directory (The Yellow Pages)*

5. Ensures that SPAN manuals are updated, as needed, after a review.

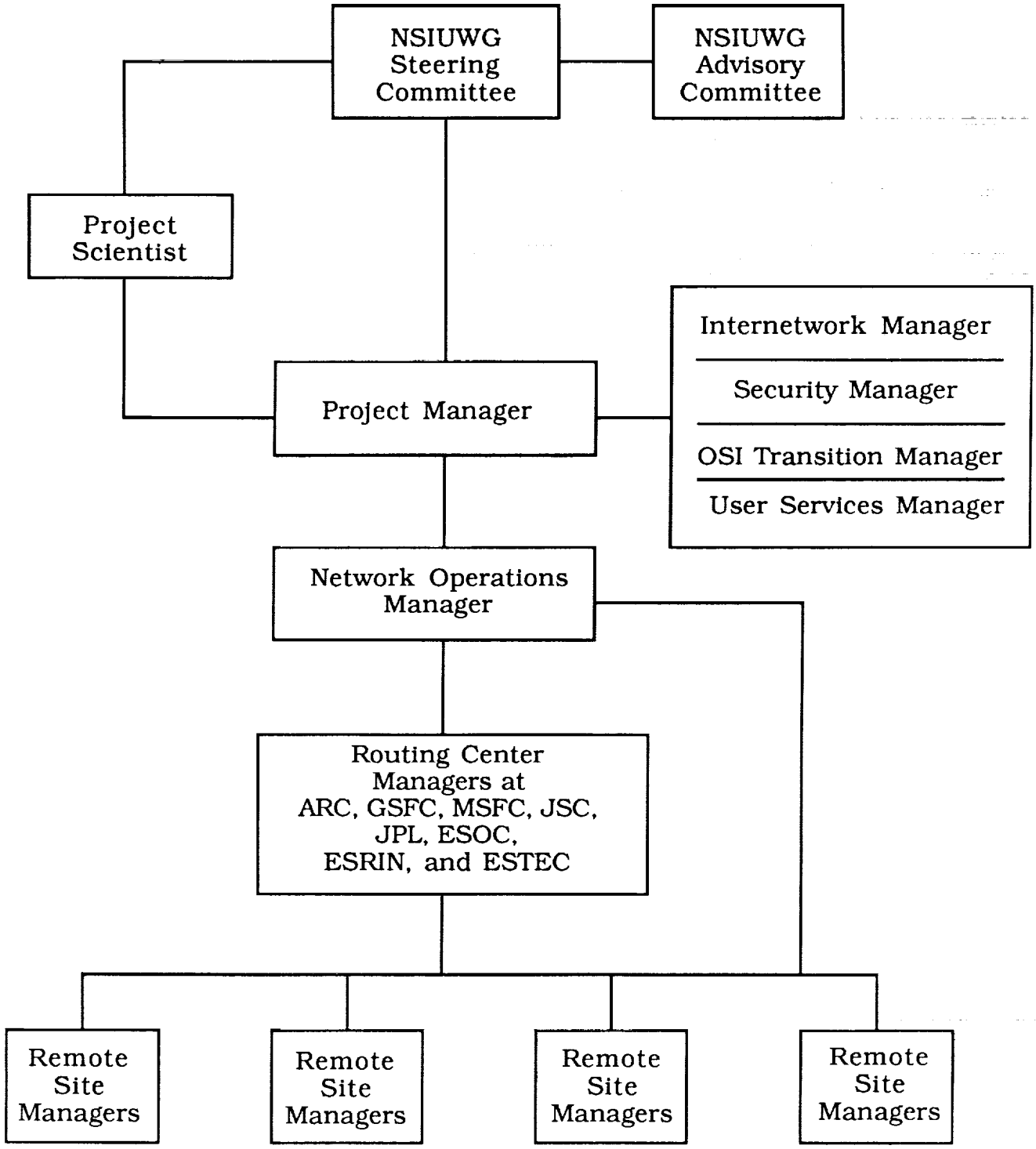

Figure 2. SPAN Management Structure

2.2 Steering Committee

The following is the list of responsibilities for the steering committee, which consists of the NSIUWG Chairperson, Project Scientist, Project Manager, and chairpersons of the various subgroups:

1. Approves all special mission-dependent uses of SPAN and presents these plans to the entire NSIUWG when possible.

2. Is the ultimate approving organization for all new node communication additions and upgrades to SPAN when the funding for those connections will be provided by NASA.

3. Has the power to make decisions governing all aspects of SPAN that are necessary during periods between NSIUWG meetings and involve short lead times.

4. Ensures that changes made in the network improve the use of the system for research use.

2.3 Project Scientist

The following is a list of responsibilities for the Project Scientist:

1. Coordinates the science activities and general network use, providing the focal point for the system.

2. Reports all SPAN activities to Code E at NASA Headquarters, keeping them advised as to the status, usage, capabilities, and future direction of the system.

3. Works with the Project Manager to develop funding projections needed to run the system. These projections are submitted to NASA Headquarters to ensure the appropriate funding level for SPAN multidiscipline activities.

4. Works with the Project Manager and the Network Operations Manager to ensure that SPAN satisfies the scientific research needs of the users.

5. Coordinates projects for SPAN use with NASA and ESA.

2.4 Project Manager

The following is a list of responsibilities for the Project Manager:

1. Organizes and holds the NSIUWG Advisory Committee meetings on a regular basis. The NSIUWG meets approximately every 9 to 12 months or sooner, in special cases.

2. Regularly reports network performance, utilization, and availability to the advisory committee (NSIUWG).

3. Keeps the advisory committee informed as to new software and hardware developments that might improve system performance.

4. Implements the NSIUWG Advisory Committee recommendations.

5. Supervises the development of SPAN, including, but not limited to:

   - Networking hardware and software
   - Data base management systems
   - Graphics and documentation standards
   - Protocols to be used in the system

6. Maintains contact with other NASA projects that require networking support. This covers those NASA projects that either have or will have connections or gateways onto SPAN.

7. Engages in long-range network planning that includes the following:

   - Predicting future growth in the network load
   - Optimizing network layout
   - Making cost-benefit analyses of alternate network routing
   - Making cost-benefit analyses of alternate technology

8. Suggests and plans for the natural evolution of SPAN to the international standard protocol ISO/OSI.

9. Negotiates purchase orders with vendors supplying network hardware and software needed for the system. This includes monitoring contract compliance for installation and checkout of hardware and software.

10. Coordinates all SPAN activities with the Project Scientist and the Network Operations Manager.

2.5 SPAN Security Manager

Although SPAN is operated as an "open" network to authorized users, the threat of electronic vandalism always exists. Insofar as SPAN has seen a marked increase in this type of activity, it was recognized that a SPAN Security Manager was required to adequately handle problems and inquiries regarding SPAN security issues.

Each SPAN site will likely have its own local procedures for handling security incidents. SPAN Management supports local security procedures, established at facilities for overall network security. The following list of responsibilities will be followed by the SPAN Security Manager. They may be used as a guide for local SPAN security procedures.

1. Acts as liaison between the GSFC Security Officer, the primary outside contact person for SPAN security investigations.

2. Coordinates network security activities, including, but not limited to:

   a. Interaction with external security organizations such as Telenet and GSFC Security.

   b. Coordination with the GSFC Security Office for the establishment of policies regarding appropriate or inappropriate measures for handling live break-ins and other hostile actions.

   c. Establishment of the measures to be taken for all security incidents. Any suspicious activity must be reported whether or not it is believed to be hostile, especially if it is in progress.

   d. Keeping user community aware of SPAN's approach to network security through speaking engagements, meetings, seminars, and revisions to the *SPAN Security Policies and Guidelines* document.

2.6 Internetwork Manager

The Internetwork Manager is responsible for the general coordination of connections between SPAN and other networks.

1. Coordinates and cooperates with wide-area DECnet networks such as HEPNET, THEnet, and UARS.

2. Coordinates international DECnet networking with European SPAN, Canadian DAN, Japanese SPAN, other international nodes.

3. Coordinates and cooperates with wide-area networks of other protocols such as TCP/IP Internet (including NSN), BITNET/EARN, and UUCP.

The Internetwork Manager is responsible for coordination of DECnet addresses with other DECnet networks (area numbers and node numbers). This also involves the coordination of DECnet Internet routing and topology.

The Internetwork Manager is responsible for long-range, high-level SPAN planning. This involves development of a strategy for migrating SPAN from DECnet Phase IV to DECnet Phase V/OSI. This must be done in such a manner that SPAN operations are minimally impacted.

The Internetwork Manager is responsible for providing DECnet technical consultation for SPAN Management in general to supplement existing DECnet expertise.

The Internetwork Manager is responsible for identifying and facilitating gateways between SPAN and other networks. Included is the general issue of interoperability between SPAN and other networks.

2.7 OSI Migration Manager

The OSI Migration Manager has the following responsibilities:

1. Takes the lead in planning DECnet transition from Phase IV to Phase V/OSI protocols.

2. Works with NSIPO engineering to create an overall plan for Code E network transition from current protocols to OSI.

3. Works with NASA Communications to ensure compatibility between Code E and non-Code E network transition to OSI protocols.

4. Coordinates all SPAN OSI migration activities with the Project Manager.

2.8 Network Operations Manager

The Network Operations Manager is responsible for the operational management of the entire network on a day-to-day basis. In addition, this person must see to the efficient use of the network's resources. The Network Operations Manager must have control over the detailed components (physical communication links and network data bases) of the network to provide maximum functionality to all SPAN users.

The authority of the Network Operations Manager is recognized by both Remote Node Managers and Routing Center Managers. Decisions made by the Network Operations Manager that involve a SPAN Routing Center must be carried out. Where a disagreement occurs, the decision will be mediated by the Project Manager and/or the Project Scientist. Decisions regarding area and node number assignments are coordinated with other wide-area networks (WANs). This activity is a joint decision among the Network Operations Manager, the Internetwork Manager, the representatives from the WANs, and the affected Routing Center Manager.

The SPAN Management Team (Project Scientist, Project Manager, Security Manager, Network Operations Manager, OSI Migration Manager, Internetwork Manager, and Routing Center Managers) has complete control over the communication allocations on the SPAN backbone. Decisions to disconnect any routing center from the SPAN backbone requires unanimous concurrence among the Network Operations Manager, the Project Manager, and the Project Scientist.

The following is a list of responsibilities for the Network Operations Manager:

1. Reports to the NSIUWG on the technical status of the network hardware and software.

2. Oversees all network operations required for dynamically maintaining the level of network service to which SPAN users are accustomed.

3. Verifies that the network is operating correctly by testing individual components and links.

4. Provides a certain level of user support by responding to complaints, problems, and questions that have been referred by Remote Site Managers.

5. Ensures high network availability:

    - Quickly recognizes a failure within the network

- Diagnoses the problem
- Minimizes the effects
- Takes corrective action to restore full service as rapidly as possible

6. Maximizes the utilization of network resources by:
   - Direct load balancing
   - Altering priorities
   - Altering routing
   - Bypassing defective components
7. Gathers data on response time and network availability to:
   - Develop user profiles
   - Develop traffic flow profiles
   - Assist Project Manager in long-range planning and reporting on problem areas and the steps taken to resolve these problems
8. Defines all DECnet areas in coordination with the Routing Center Managers, the Internetwork Manager, and other local networks to which SPAN will be connected or is currently connected.
9. Resolves any contention problems between SPAN access and other local or wide-area networks that occur across the network. These problems are discussed and resolved with the affected Routing Center Manager.
10. Coordinates new network tail circuit installations with the PSCN, Remote Node Manager, and respective Routing Center Manager. Administrative details will be included in the next SPAN DECnet data base update.
11. Performs the following for special project uses:
    - Assesses and reports the overall impact on the network
    - Works with the Project Scientist and Project Manager to establish baseline SPAN capability.
    - Relays all necessary information to the Routing Center Managers to ensure full support during mission-specific events carried out over SPAN.

2.9 Routing Center Manager

SPAN backbone circuits terminate at NASA or ESA sites that perform the routing of network traffic to tail circuits. These sites are the primary routing centers and, therefore, require a Routing Center Manager. This person is responsible for seeing that routing functions are performed properly within the context of overall SPAN traffic flow. As a minimum, these responsibilities must be covered at six major SPAN routing centers: ARC, GSFC, MSFC, JSC, JPL, and ESOC. As the network expands, additional routing centers may be required. This need will be determined collectively by the SPAN Management Team.

The following is a list of responsibilities for the Routing Center Manager:

1. Manages the network circuits coming into the routing center to ensure that all lines to and from the local gateway are operational and modems at the local and remote site are functional.

2. Maintains awareness of the PSCN future requirements and takes necessary action to accommodate them. If there is any difficulty, it must be brought to the attention of SPAN Management for resolution.

3. Any problems with the physical communication links to or from the routing center's SPAN lines are discussed with the Network Operations Manager. At the discretion of the Routing Center Manager, the Network Operations Manager may be contacted to discuss a course of action toward resolution of the problem, including, but not limited to, rebooting the router or restarting the local portion of the network.

4. Maintains and operates the SPAN DECnet routers and servers at the routing center to ensure that:

   - The routing center hardware is operational with a minimum of downtime.

   - The network routing software is maintained at the most current revision level as specified by the respective manufacturers.

   - All tail circuits' performance is optimized.

   - All temporary node assignments are made according to the policy as described in the Remote Node Requirements section.

5. Is familiar with all local area networks connected to SPAN. When situations arise that put the local area network into contention with SPAN, then SPAN must be given the highest priority if a SPAN link is to be maintained.

6. Coordinates any problem-solving sessions with the Network Operations Manager. The need to have a discussion is at the discretion of the Routing Center Manager.

7. Notifies the SPAN User Services Manager and Remote Site Managers whose equipment is connected to that routing center of all times that SPAN access will be unavailable for more than 24 hours because of local maintenance or communication problems at the routing center.

8. Notifies the SPAN Security Manager of all security incidents.

9. Optionally, performs all network functions of the Remote Node Manager when the situation requires. The responsibility issues for these circumstances must be separately negotiated for each incident that requires the intervention of the Routing Center Manager.

10. Coordinates new network nodes coming into the routing center with the Network Operations Manager and other members of the SPAN Management Team as appropriate. This includes the assignment of node addresses.

11. Coordinates the solution to major line communication problems and any required testing with the Remote Node Manager(s).

12. Resolves all physical line problems with the MSFC PSCN Network Control Center (NCC) and the affected site's communication personnel.

13. Serves as the focal point for all communication link problems and is recognized as the SPAN contact by the MSFC/PSCN Network Control Center and any affected node or routing center.

14. Informs all affected Remote Node Managers when mission-specific support requires SPAN usage.

15. Handles NSN TCP/IP responsibilities as given by NSN Management at NASA/ARC.

2.10 SPAN User Services Manager

NSSDC manages and operates the SPAN Network Information Center (NIC). It also maintains an online data base system called SPAN_NIC. The Network Information Center serves as the primary liaison between SPAN Management and its user community. The User Services Manager is responsible for coordinating the activities of the NIC and assuring that it effectively serves the SPAN user community.

The NIC Coordinator cooperates closely with the Network Operations Manager and the Routing Center Managers. The key indicator of success of the Network Information Center is a high response level with the SPAN user community. User requests that would have an impact on the operation or configuration of the network must be cleared with the Network Operations Manager before being granted. Network management decisions that affect user service must be conveyed to the SPAN community quickly.

The following is a list of responsibilities for the User Services Manager:

1. Monitors SPAN Network Information Center telephone and electronic mail messages, responding to users in a timely manner. In many cases, messages will need to be forwarded to a Routing Center Manager, the Network Operations Manager, the Internetwork Manager, the OSI Migration Manager, the SPAN Security Manager, the Project Manager, or the Project Scientist for proper attention.

2. Maintains accurate and timely online information about network resources available to users. This includes, but is not limited to, the SPAN_NIC account available to the SPAN user community.

3. Keeps the Network Operations Manager informed of scheduled activities that may impact the network, such as preventive maintenance outages, tests, and other special events.

4. Maintains online SPAN documentation by following configuration management procedures to assure a smooth and orderly update process.

5. Assists Remote Node Managers with the task of instructing their users in the utilization of network services.

6. Maintains the currency and accuracy of the SPAN_NIC data base with respect to both node and user-level information.

7. Acts as the liaison with the users to develop requirements for the evolution of the user interface software for the SPAN_NIC account.

8. Keeps the SPAN DECnet data base up to date and coordinates node names.

2.11 Remote Site Manager

The Remote Site Manager is responsible for contacting the Routing Center Manager when circuit problems arise or when power outages are expected or occur. This person can be of great assistance to a Routing Center Manager. The respective Routing Center Manager may choose to identify individuals to fill this role at as many sites as required, even though they may not officially hold this title.

The following is a list of responsibilities for the Remote Site Manager:

1. Keeps the respective Routing Center Managers informed of all activities at their site that could affect the connectivity or routing of network traffic at their site, such as:

   - Planned maintenance outages
   - Hardware failures
   - Major changes in hardware or software configuration
   - Changes in the local resources available to the network
   - Any extended downtime at their sites

2. The Remote Site Manager must register all new node names with the respective Routing Center Manager. This information will be used to allow the nodes to be included in the SPAN DECnet data base.

3. Immediately reports problems with physical communication links to the respective Routing Center Manager for resolution.

4. Maintains all connections with other local area networks and ensures compatibility with SPAN. If contention arises that is not easily resolvable, the respective Routing Center Manager must be informed to ensure SPAN security and functionality.

5. Acts as a point of distribution of routing center information to the local site computer managers.

2.12 Remote Node Manager

Each node in SPAN must have an individual who will accept responsibility for that organization's node in the network. The Remote Node Managers must keep the Routing Center Manager and Network Operations Manager informed of any action involving their nodes that may affect the network. Frequently, the Remote Node Manager is the System Manager for that computer. The Remote Node Manager will need to have sufficient system privileges to complete requests from SPAN Management in order to ensure proper operation of the network. The close cooperation of the Remote Node Manager with the Routing Center Manager, Security Manager, and Network Operations Manager is critical to successful network management.

The following is a list of responsibilities for the Remote Node Manager:

1. Maintains the hardware and software of the remote node in the network.

2. Guarantees the general compatibility of the remote node with the network.

3. Educates users who join the network through the remote node as to proper conduct and procedures as specified in the *Introduction to the Space Physics Analysis Network (SPAN)* booklet.

4. Ensures that the information pertaining to the local resources at the remote node is accurate and available to the network in a timely fashion.

5. Answers user complaints, questions, and problems concerning the network for those users entering the network through that remote node. Problems and questions that cannot be resolved must be referred to the respective Routing Center Manager or other knowledgeable personnel.

6. Registers his or her node information with the SPAN Services Manager. This information will be part of the SPAN_NIC online data base system.

7. Keeps the respective Routing Center Manager informed of all activities at the remote site that could affect the connectivity or routing of network traffic at that site, such as:

   - Planned maintenance outages

   - Hardware failures

- Major changes in hardware or software configuration
- Changes in the local resources available to the network
- Any extended downtime

8. Immediately reports problems with physical communication links to the respective Routing Center Manager for resolution.

9. Maintains all connections with other local area networks and ensures compatibility with SPAN. If contention arises that is not easily resolvable, the respective Routing Center Manager must be informed to ensure SPAN security and functionality.

10. Supplies the SPAN Security Manager with appropriate, required accounting information and background information when a security incident happens on that system.

3. Technical References

The following list of publications is acknowledged as providing key ideas discussed in this manual. Much of this manual has been developed from the reporting of historical experiences and collections of articles from sources too numerous to mention outside of the current SPAN routing center managers.

1. Green, J. L., V. L. Thomas, B. Lopez-Swafford, L. Z. Porter, *Introduction to the Space Physics Analysis Network (SPAN)*, NSSDC Technical Report, Second Edition, January 1987.

2. Peters, D. J., P. L. Sisson, J. L. Green, V. L. Thomas, *Space Physics Analysis Network Node Directory (The Yellow Pages)*, Fourth Edition, NSSDC/WDC-A-R&S 89-14, August 1989.

Appendices

Appendix A

NSI Users Working Group (NSIUWG)

Officials and Subgroup Chairpersons

Chairperson:	Dr. Ronald Zwickl, NOAA/SEL	SELVAX::RZWICKL
Secretary:	Dr. James Green, NSSDC	NCF::GREEN
Policy:	Dr. Ronald Zwickl, NOAA/SEL	SELVAX::RZWICKL
Networking:	Linda Porter, MSFC	SSL::PORTERL
Security:	Ron Tencati, NSSDC	NCF::TENCATI
Standards:	Dr. Dennis Gallagher, MSFC	SAM::GALLAGHER
User Services:	Dr. Neal Cline, UCLA	UCLASP::NCLINE

Appendix B

SPAN Management Team

Project Scientist (NASA):	
Dr. James Green, NSSDC	NCF::GREEN
Project Scientist (ESA):	
Dr. Trevor Sanderson, ESTEC	ESTCS1::TSANDERS
Project Manager:	
David Peters, NSSDC	NCF::PETERS
Security Manager:	
Ron Tencati, NSSDC	NCF::TENCATI
Internetwork Manager:	
David Peters, NSSDC (Acting)	NCF::PETERS
OSI Migration Manager:	
Linda Z. Porter, MSFC	SSL::PORTERL
Network Operations Manager:	
Linda Z. Porter, MSFC (Acting)	SSL::PORTERL
User Services Manager:	
VACANT	NCF::NETMGR
GSFC Routing Center (Mid-Atlantic to N.E. United States and Japan):	
Todd Butler, NSSDC	NCF::TBUTLER
Dave Stern, NSSDC	NCF::STERN
European SPAN Manager	
Gerbrand Veldman (ESTEC)	ESTCS1::GVELDMAN
ESTEC Routing Center Manager	
Gerbrand Veldman (ESTEC)	ESTCS1::GVELDMAN
ESOC Routing Center Manager	
Paul Hughes	ECD1::NETMGR
ESRIN Routing Center Manager	
Jordi Pascual	ESRIN1::JORDI

JSC Routing Center (S.W. United States to Plains states):	
Dan Anderson	SN::DAN
Bob Colvin	SN::COLVIN
JPL Routing Center (western United States):	
Sandy George	JPLNG::GEORGE
Don Gallop	JPLGP::GALLOP
MSFC Routing Center (S.E. United States to Midwest):	
Linda Porter	SSL::PORTERL
Dennis Gallagher	SAM::GALLAGHER
AMES Routing Center	
Warren VanCamp	EAR::VANCAMP

The current list of SPAN remote node managers is found in the *Space Physics Analysis Network Node Directory (The Yellow Pages).*

Appendix C
Glossary/Acronyms

The following terms appear in SPAN documents and are described here to establish a common context in their discussions.

ARC Ames Research Center, Moffett Field, California (One of the SPAN backbone routing centers)

ARPAnet Advanced Research Projects Agency Network

BITnet Because Its Time (or There) Network

DEC Digital Equipment Corporation

DECnet DEC networking products generic family name

DSUWG Data Systems Users Working Group (The science user group acting as the advisory committee to SPAN project management)

ESA European Space Agency

ESOC European Space Operations Centre (One of the SPAN backbone routing centers)

ESRIN European Space Research Institute

ESTEC European Space and Technology Center

Gateway A special-purpose network node that converts the functions of one network into functions recognizable by another, similar to what a language translator would do

GSFC Goddard Space Flight Center, Greenbelt, Maryland

HEPnet High Energy Physics Network (U.S. Department of Defense)

Host Any network node that a user can access for processing power, information, and applications. Hosts are general-purpose nodes that are *not* designed to perform network-specific functions.

ISO/OSI	International Standards Organization/Open Systems Interconnect
JPL	Jet Propulsion Laboratory, Pasadena, California (One of the SPAN backbone routing centers)
JSC	Johnson Space Center, Houston, Texas (One of the SPAN backbone routing centers)
kbps	Kilobits per second
KSC	Kennedy Space Center, Cape Canaveral, Florida (One of the SPAN backbone routing centers)
LAN	Local area network (Usually spans a limited geographical area, such as a building or cluster of buildings, using high-speed data transfer)
LANL	Los Alamos National Laboratory, Los Alamos, New Mexico
MSFC	Marshall Space Flight Center, Huntsville, Alabama (One of the SPAN backbone routing centers)
NASA	National Aeronautics and Space Administration
NCC	PSCN Network Control Center (located at MSFC)
Network	Two or more computers or intelligent devices linked via physical communication media (cables, telephone lines, satellites) for the purpose of information exchange and resource sharing
NIC	Network Information Center
Node	An intelligent device on a network
NPSS	NASA Packet Switched System (X.25 protocol)
NSSDC	National Space Science Data Center, Greenbelt, Maryland (One of the SPAN backbone routing centers and headquarters for SPAN operations at GSFC)
Packet	A unit of information comprising user data and the control information needed to ensure that the data arrives at their proper destination
Packet Switch	The communications technology used by PSDN nodes to interleave the packets of many users and direct them to their destinations

Protocol In a networking context, a set of rules and formats for the exchange of messages between communication devices

PSCN Program Support Communications Network

Routing The capability that enables an intermediary node on the path between a source and a destination node to pass/direct messages through to the destination

SPAN Space Physics Analysis Network

TCP/IP Transmission Control Protocol/Internet Protocol

Telenet A public packed-switch network owned by GTE

THEnet Texas Higher Education Network

Topology The geometric pattern in which the lines and nodes of a network are arranged

WAN Wide area network (Usually spans a large geographical area, such as several cities, countries, or continents)