

**Network Control Center
Data System (NCCDS)
Specification
for World Wide Web Server for
TDRSS Unscheduled Time and
Nascom Information**

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Preface

This document describes the Network Control Center (NCC) Data System (NCCDS) World Wide Web (WWW) Server operational concepts, interfaces to other NCCDS systems and external systems, and the implementation schedule. This document provides detail for the design, development and implementation of the requirements for presenting TDRSS Unscheduled Time (TUT) and Nascom Information to NCC customers and to the Nascom Operations Center (NOC), and serves to coordinate the interfaces between the WWW Server and other elements of the NCCDS and the Space Network (SN). The information in this document will ultimately be recorded in the NCCDS System Design Specification and the NCCDS Operational Concepts.

Information presented herein was prepared by the Network Control Center Project, Code 530.5, Goddard Space Flight Center (GSFC). Any questions, recommended changes, or comments should be directed to:

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Abstract

This specification describes the NCC Data System (NCCDS) World Wide Web (WWW) Server operational concepts, interfaces to other NCCDS systems and external systems, and the implementation schedule.

Keyword: *Network Control Center, requirements, specification, interfaces, Space Network, TDRS, TDRSS*

Contents

Section 1. Introduction

1.1 Background	1-1
1.2 Scope.....	1-1
1.3 Assumptions.....	1-1
1.3.1 Nascom Information	1-1
1.3.2 Security of Nascom Information	1-2
1.3.3 Reconfiguration of Nascom Information.....	1-2
1.4 Applicable Documents.....	1-2

Section 2. System Environment

2.1 NCCDS System Overview	2-1
2.2 Operational Environment.....	2-2
2.3 Customer Environment	2-3
2.4 WWW Server Interfaces	2-3
2.5 Performance	2-3

Section 3. System Concepts and Scenarios

3.1 TDRSS Unscheduled Time	3-1
3.2 Nascom Information	3-1
3.3 System Management.....	3-2

Section 4. Interfaces

4.1 SPSR.....	4-1
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DRAFT

4.2 Customer, NCC Workstations and Nascom Operations Center	4-1
4.3 NSM.....	4-2
4.4 Firewall.....	4-2

Section 5. Design and Implementation

5.1 Design Approach.....	5-1
5.2 Implementation Schedule.....	5-1

Section 6. Issues

6.1 "Freshness" of TUT Information	6-1
6.2 Contents of the Nascom Information	6-1

Abbreviations and Acronyms

Figures

Figure 2-1. NCC 98 Architecture.....	2-1
Figure 2-2. Web Server Architecture	2-2

Tables

Table 4-1. TDRSS Unscheduled Time File Format	4-3
Table 4-2. Nascom Information File Format.....	4-5

Section 1. Introduction

1.1 Background

Tracking and Data Relay Satellite (TDRS) Unscheduled Time (TUT) is a table indicating unscheduled resources of the TDRSs of the Space Network (SN). It consists of start and stop times of unscheduled use of the Single Access (SA), Multiple Access Forward (MAF), and S-band Multiple Access Forward (SMAF) antennas, and Multiple Access Return (MAR) and S-band Multiple Access Return (SMAR) links for each TDRS. This data is essentially the unused time in the schedule, with a few adjustments due to flexible events with flexible start and stop times and/or flexible resources. The TUT is not sensitive, and will be made available to all customers on the NASA Communications (Nascom) Internet Protocol (IP) Operational Network (IONET). Customers currently receive TUT from the NCC via e-mail.

The information to be provided to Nascom is essentially the contents of the baseline Nascom Event Schedule (NES) message and the Nascom Event Cancel (NEC) message, without the Multiplexor/Demultiplexor (MDM) setup parameters (which will no longer be relevant in an IP network). Because this information identifies actual schedule information for all SN users of IONET, it is assumed to be more sensitive than the TUT information and should be made available only to the Nascom Operations Center (NOC).

1.2 Scope

This document contains:

- a. the operational concepts for providing TUT and Nascom Information via a World Wide Web (WWW) database interface
- b. identification of other documents in the NCC 98 project affected by this specification
- c. interfaces between the WWW Server and other NCC 98 and external systems
- d. implementation plans and schedule
- e. direction of future work for machine access to TUT information (TBS)

1.3 Assumptions

1.3.1 Nascom Information

It is assumed that the NOC for IONET will require information concerning the scheduled Space Network use of IONET. This information is assumed to be essentially the contents of the current NES, without the setup parameters for the MDMs.

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1.3.2 Security of Nascom Information

It is assumed that the information provided to Nascom is more sensitive than the TUT information. The security assumed for Nascom Information is:

- a. The WWW Server shall perform Identification and Authentication (I&A) and authorization of the requesting user (NOC)
- b. The WWW Server shall provide I&A information to the Nascom user
- c. The SN schedule information sent to the Nascom server shall be encrypted
- d. The NCC Firewall may also provide additional security (TBS)

1.3.3 Reconfiguration of Nascom Information

The baseline NCCDS also sends reconfiguration messages to the Nascom Control and Status System (CSS). It is assumed that the NOC does not need information on reconfigurations of SN users' data streams.

1.4 Applicable Documents

The following documents are directly applicable to the NCCDS WWW Server. Documents applicable to the interfaces between the NCCDS and its customers will require an update for any message format changes applicable to NCCDS.

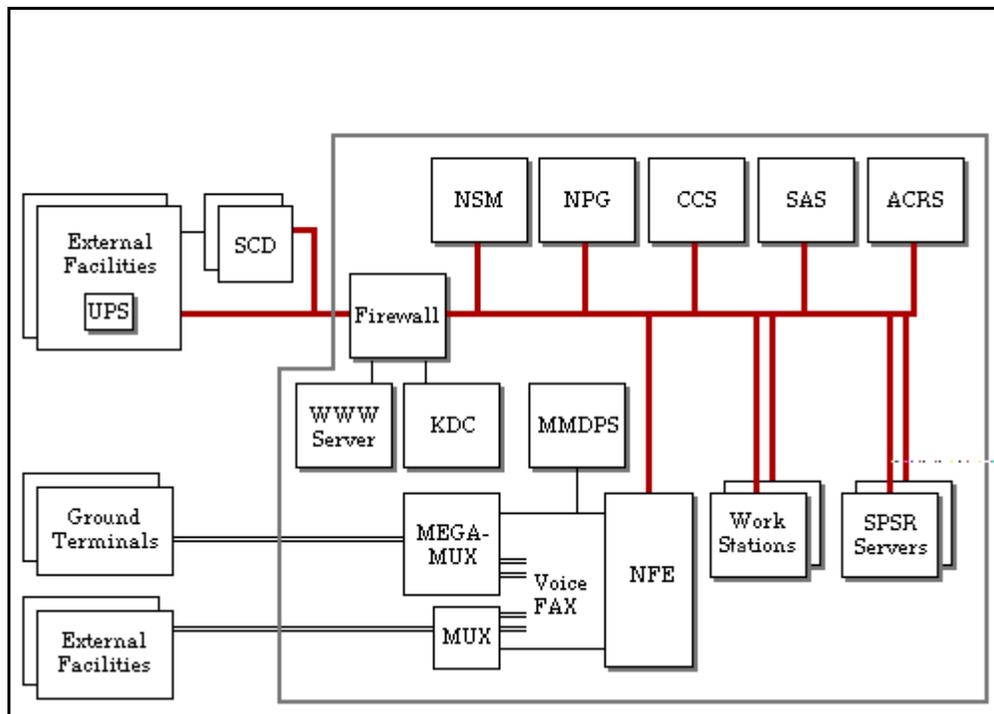
- a. *Network Control Center Data System (NCCDS) System Requirements, 1998, Revision 1, October 1996, 530-SRD-NCCDS/1998*
- b. *Network Control Center Data System (NCCDS) Operations Concept, 1998, June 1996 (Draft), 530-OCD-NCCDS/1998*
- c. *Interface Control Document Between the Network Control Center Data System and the Mission Operations Centers, 530-ICD-NCCDS/MOC*
- d. *Network Control Center Data System Project Management Plan, 1998, 530-PMP-NCCDS/1998*
- e. *Network Control Center Data System (NCCDS) System Design Specification, 1998, October 1996 (Draft), 530-SDS-NCCDS/1998*
- f. *Shuttle Mission Control Center External Communications Interface Control Document, Communications Interface Between the Johnson Space Center Mission Control Center and the Goddard Space Flight Center Network Control Center, JSC 11534, Volume V*
- g. *Interface Control Document Between the Network Control Center Data System and the NASCOM Control and Status System, Revision 2, August 1995, 530-ICD-NCCDS/NASCOM*

Section 2. System Environment

2.1 NCCDS System Overview

Section 3 of the *NCCDS Operations Concept, 1998*, provides an overview of the NCCDS and discussion of the system environment. This paper supplements those descriptions with the inclusion of the WWW Server for TUT and Nascom Information. As shown in Figure 2-1, the WWW Server is located on a subnet of the NCCDS firewall. Figure 2-2 shows the architecture of the message flow for the WWW Server. The Service Planning Segment Replacement (SPSR) provides the TUT and Nascom Information to the WWW Server, which maintains local copies. The WWW Server responds to requests for this information from external Web browsers by extracting the requested information from the local copies, formatting it in an HTML page, and returning it to the requester.

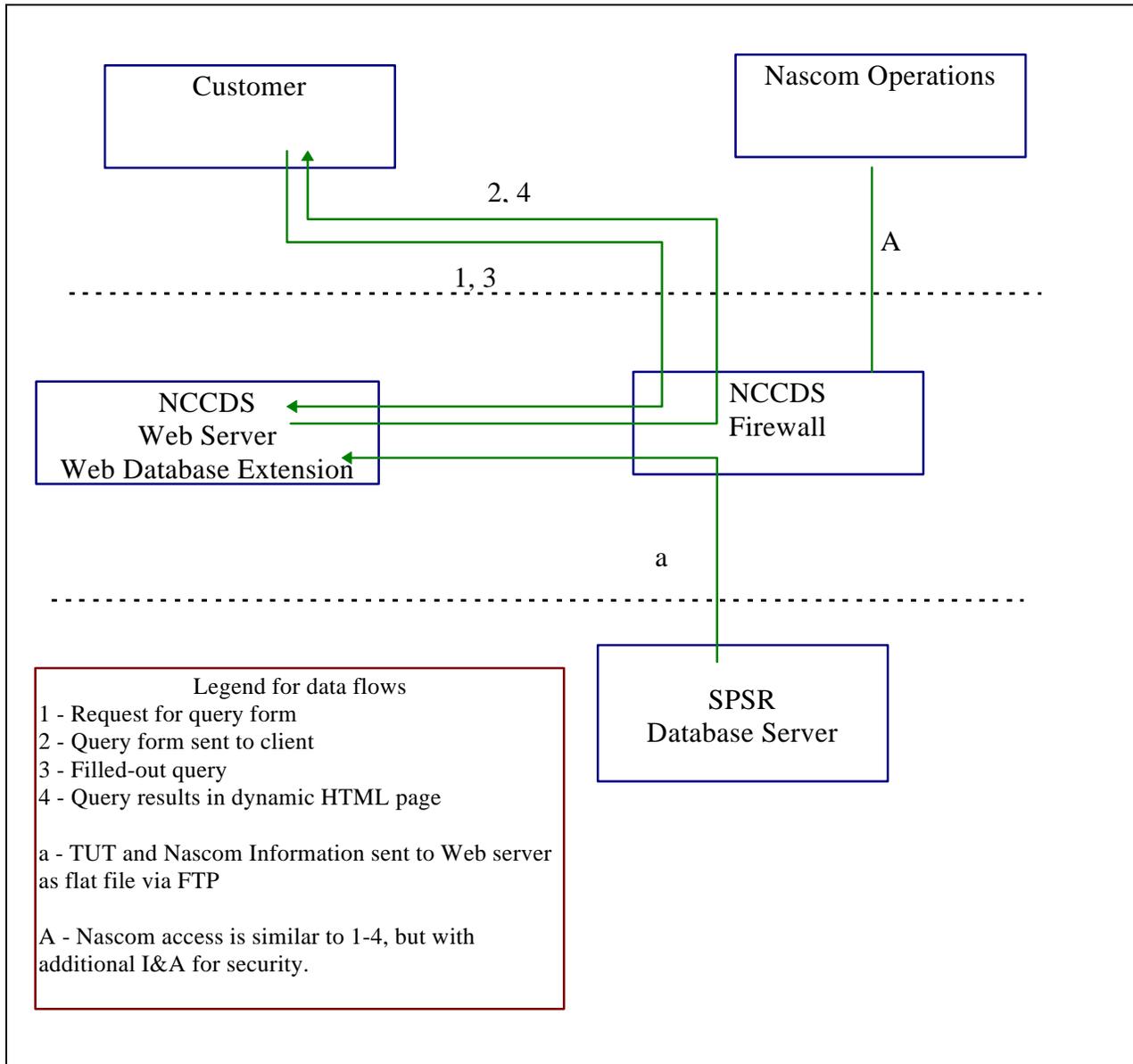
Figure 2-1. NCC 98 Architecture



TUT information may be obtained by any external user. The Nascom Information is assumed to be more sensitive, because it contains actual scheduled services identified by customer. This information will be provided in an encrypted form after identification and authentication (I&A) of the requester has been performed. SSL/https, SHTTP, Kerberos, and smart cards (Fortezza, SmartCat) are I&A technologies that are being evaluated; the selection will be made during the detailed design phase.

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Figure 2-2. Web Server Architecture



2.2 Operational Environment

The WWW Server is a component of the NCCDS and as such must conform to the general requirements placed on all such components. These requirements are specified in the System Requirements Document (SRD), Sections 9, 10 and 11.

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2.3 Customer Environment

The customer uses a computer connected to IONET and a Web browser running on that computer to access the NCCDS WWW Server. Depending on the I&A technology selected, the Nascom customer may also require an authorizing certificate issued by an appropriate Certifying Authority or a smart card such as Fortezza. This implementation of the TUT and Nascom Information meets the requirements for a human-readable form of the data; the machine-readable access for TUT Information will be addressed in a later release. As an interim, the customer could save the Web page to disk, parse it and generate input data for the customer's automated scheduling system.

2.4 WWW Server Interfaces

The NCCDS WWW Server has interfaces with the following internal and external systems:

- a. Mission Operation Centers (MOCs)
- b. Nascom
- c. NCC Operator Workstations
- d. SPSR Database Server
- e. NSM
- f. Firewall

These interfaces are described in detail in Section 4. The following documents must be updated to incorporate the TUT and Nascom Information:

- a. *Network Control Center Data System (NCCDS) Operations Concept, 1998, June 1996 (Draft), 530-OCD-NCCDS/1998*
- b. *Interface Control Document Between the Network Control Center Data System and the Mission Operations Centers, 530-ICD-NCCDS/MOC*
- c. *Shuttle Mission Control Center External Communications Interface Control Document, Communications Interface Between the Johnson Space Center Mission Control Center and the Goddard Space Flight Center Network Control Center, JSC 11534, Volume V*

In addition, the NCCDS/NOC interface must be defined in TBD document.

2.5 Performance

The workload of the WWW Server shall be computed from the workload specified in the SRD, Section 9.8 and the performance requirements in Section 5.9. There is no specific requirement for the response time for a query for TUT or Nascom Information; the requirements for response times for the NCCDS as specified in the SRD, Section 9.9.2 will be used as guidelines.

Section 3. System Concepts and Scenarios

3.1 TDRSS Unscheduled Time

The TDRSS Unscheduled Time encompasses the period from the current time to the end of the active schedule. Within this period there are both fixed and flexible events. Because of the complexity of determining the resources and times to be used for the TUT calculations, it is expected that the scheduling engine in SPSR will be used to create a temporary fixed schedule for this purpose.

The NCC Operator will be able to specify periodic generation of the TUT information and also manually initiate generation of the information. The output of the TUT calculation will be automatically transferred to the WWW server via FTP after generation.

NOTE 3.1-1

The periodicity of TUT generation will be determined after the performance of the SPSR scheduling system is known. It must be sufficiently frequent to meet the needs of the customers, but not so frequent as to impair the performance of other SPSR systems. This issue is described in Section 6.1.

NOTE 3.1-2

The use of FTP to transfer the file is based on using a simple, well-understood protocol for the WWW Server-SPSR Server connection. Firewall technology is still weak for securing more complex protocols, such as SQL queries. This design decision will be reviewed during the detailed design phase.

The customer who desires to view the TUT information will use his WWW browser to access the TUT URL. A query page is returned, on which the customer may select the time periods, services and TDRSs for the desired TUT information. When the customer selects the Submit button on the page, the query is sent to the NCCDS WWW Server, which extracts the specified information based on the query, formats it on an HTML page, and returns it to the customer.

3.2 Nascom Information

The Nascom Information specifies the scheduled data flows over the Nascom IONET, the High Data Rate Multiplexer (HDRM), and Shuttle video and analog circuits for those events that have been transmitted to the White Sands Complex (WSC). No other SN resources (e.g., Local Interface ports) are included in this information. This information includes all possible dataflows; the initially configured dataflows are indicated by non-zero data rates. Because these are fixed events, the information is contained in the SPSR database and can be extracted by a relatively simple program or stored procedure.

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The Nascom Information will be generated by the SPSR whenever a SHO or SHO Cancel message is transmitted (e.g., during a schedule activation or a single event update). The Nascom Information will be automatically transferred to the WWW Server via FTP after generation. The NCC operator may enable or lock out access to the Nascom Information on the WWW Server.

The Nascom operator may view the Nascom Information by using a WWW browser to access the Nascom Information URL. Depending on the security technique selected (TBD), the Nascom operator may have to use a specific computer that contains the authorizing certificate or use a computer with the appropriate hardware (such as for the Fortezza card). A query page is returned, on which the Nascom operator may select the time period(s), customer(s), ground terminal(s), user interface channel(s), and ground terminal port(s) for the desired Nascom Information. When the Nascom operator selects the Submit button on the page, the query is sent to the NCCDS WWW Server, which extracts the specified information based on the query, formats it on an HTML page, and returns it to the Nascom operator.

3.3 System Management

Section 9.5.2 of the System Requirements Document contains requirements for system management of the NCCDS. It is expected that the Network and System Manager (NSM) will provide the required functionality; the WWW Server will contain the appropriate software for management by the NSM.

Section 4. Interfaces

4.1 SPSR

The SPSR shall copy the TDRSS Unscheduled Time to the WWW Server whenever new TUT information is available. The copy function shall be via FTP with account name [TBS] and password [TBS], into directory [TBS] and file name [TBS]; refer to Note 3.1-2 for further discussion.

The TDRSS Unscheduled Time file is an ASCII file with the format shown in Table 4-1. Note that a TDRS that is not available during the active period will not appear in the list of TDRSs, and that only resources with unscheduled time will appear in the list.

The SPSR shall copy the Nascom Information to the WWW Server whenever new Nascom Information is available. The copy function shall be via FTP with account name [TBS] and password [TBS], into directory [TBS] and file name [TBS]; refer to Note 3.1-2 for further discussion.

The Nascom Information file is an ASCII file with the format shown in Table 4-2.

4.2 Customer, NCC Workstations and Nascom Operations Center

The customer interface to the WWW Server consists of a Commercial Off-the-Shelf (COTS) Web browser supporting the latest HTML version (currently HTML 2.0) and the HTML pages provided by the NCCDS WWW Server. Validation of input data at the client side will be provided in either JavaScript and/or VBScript (TBD); validation will also be done on the NCCDS WWW Server. Although the primary customers of the TUT and Nascom Information are expected to be external users, internal NCC Workstations may also access the WWW Server in the same way as an external user.

The Web page layouts will be developed during the detailed design phase, in cooperation with the customers. The following pages are currently planned:

- a. A page that will provide for selection of TUT and a page that will provide for selection of Nascom Information
- b. The TUT Selection page will provide user specification of time range, TDRSs and resources, as specified in the SRD, Section 5.11.3.3, and other filters such as minimum duration (TBD). The defaults are the entire active schedule, all TDRSs and all resources.
- c. The TUT Information page will provide the TUT information, filtered as requested and sorted by TDRS, antenna, link and start time, with an "As of" time field that indicates when the TUT information was generated from the active schedule.
- d. The Nascom Selection page will request the appropriate identification and authentication from the NOC, depending on the particular tools selected (TBD). The

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page will provide user specification of time period(s), customer(s), ground terminal(s), user interface channel(s), and ground terminal port(s), as specified in the SRD, Section 5.6.2.6.3, and a selection of sort order (TBD) for the information.

- e. The Nascom Information page will provide the Nascom Information, filtered and sorted as requested, with an “As of” time field that indicates when the Nascom Information was generated from the active schedule.

4.3 Network and System Manager (NSM)

The WWW Server shall normally be managed by the NSM, and it shall provide for system configuration, startup, shutdown and status reporting. These functions are planned to be provided by COTS software on the WWW Server and the NSM; the details of these interfaces depend on the hardware and software selected. The WWW Server may also be managed via its local console interface.

4.4 Firewall

The WWW Server is physically connected to the firewall on a subnet, and all traffic to and from the WWW Server flows through the firewall. The firewall is transparent to the WWW Server; however, the firewall must be configured to support the services that the WWW Server provides:

- a. HTTP
- b. SSL/https or an equivalent secure protocol for Nascom Information
- c. FTP
- d. SNMP

The details are TBS.

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Table 4-1. TDRSS Unscheduled Time File Format

Line	Contents	Description
1	“TDRSS Unscheduled Time Report”	File Title
2	“As of yyyy/ddd/hh:mm:ss”	The time at which the TUT Information was generated. yyyy is the year, ddd is day of year, hh is the hour of the day (00-23), mm is the minutes of the hour, and ss is the seconds of the minute.
3	“TUT Stop Time yyyy/ddd/hh:mm:ss”	The time of the end of the active schedule when the TUT was generated.
4	TDRS Unscheduled Time entry	Each unscheduled time entry is a separate line. The components are listed below. The components are separated by one or more ASCII spaces.
4.1	TDRS	TDRS Operational Name; three alphanumeric characters
4.2	Antenna/Link Type	“SA”, “MAF”, “MAR”, “SMAF”, or “SMAR”. See Note 4.1-1
4.3	Antenna/Link Identification	A two digit number with leading zeroes representing the specific antenna/link; refer to Note 4.1-2. For MAF or SMAF, use “01”
4.4	Start Time	StartTime is the start of the Unscheduled Time, in the format yyyy/ddd/hh:mm:ss.
4.5	Stop Time	StopTime is the end of the Unscheduled Time, in the format yyyy/ddd/hh:mm:ss.
5-n	This entry repeats up to the number of entries in the TUT report. The entries are sorted in ascending order on the key TDRS + Antenna/Link Type + Antenna Link Identification + StartTime.	

NOTE 4.1-1

“MAF” and “MAR” apply to the current TDRSs; “SMAF” and “SMAR” apply to TDRS H,I,J.

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NOTE 4.1-2

The link identification is provided to identify separate blocks of unscheduled time on resources of the same type and TDRS. The customer cannot specify the MAR/SMAR link ID, and should use flexibility on Schedule Add Requests by not specifying the SA antenna.

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Table 4-2. Nascom Information File Format

Line	Contents	Description
1	“Nascom Information”	File Title
2	“As of yyyy/ddd/hh:mm:ss”	The time at which the Nascom Information was generated. yyyy is the year, ddd is day of year, hh is the hour of the day (00-23), mm is the minutes of the hour, and ss is the seconds of the minute.
3	Nascom Information Entry	Each Nascom Information entry is a separate line. The components are listed below. The components are separated by one or more ASCII spaces.
3.1	SUPIDEN	Support Identifier: 7 Alphanumeric Characters
3.2	Event Start Time	Start time of the event in the format yyyy/ddd/hh:mm:ss
3.3	Event Stop Time	Stop time of the event in the format yyyy/ddd/hh:mm:ss
3.4	TDRS	TDRS Operational Name: three alphanumeric characters.
3.5	Ground Terminal	Supporting Ground Terminal: “WSGT” or “STGT”
3.6	Data Stream Start Time	Start time of the data stream in the format yyyy/ddd/hh:mm:ss
3.7	Data Stream Stop Time	Stop time of the data stream in the format yyyy/ddd/hh:mm:ss
3.8	Stream Direction	“F” for a forward stream, “R” for a return stream

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Table 4-2. Nascom Information File Format (Continued)

3.9	Stream Type	Specifies the type of communication channel used: “IP” for the IP Operational Network (IONET) “HDRM” for the High Data Rate Multiplexer “Video” for Shuttle Video “Analog” for Shuttle Analog
3.10	Data Rate	Data rate, in bits per second for digital data flows, for the initially configured data stream; “0” for non-digital data flows and for data streams to which the service may be reconfigured.
3.11	Ground Terminal Port	The ground terminal port that is the source (for return data) or the destination (for forward data) of the stream: MDM: 4 hex digits HDRM: the HDRM port (“1” through “4”) Video: “Video” Analog: “Analog”
3.12	User Interface Channel	The identifier used to specify the customer’s communication channel: 3 alphanumeric characters
4-n	The remaining lines repeat the format of line 3; there is no sort order (TBR)	

Section 5. Design and Implementation

5.1 Approach

A package-based methodology is appropriate for the implementation of the WWW Server, because it is primarily COTS products with some custom software. This approach consists of:

- a. selecting and acquiring packages based on fit of package capabilities with requirements
- b. determining that the packages work as expected
- c. determining that package integration is routine and not a major effort
- d. implementing the custom software (e.g., Perl scripts) and obtaining customer involvement with the design
- e. testing the system to obtain performance metrics for sizing the delivered system
- f. holding a formal review
- g. “armor-plating” the system as needed (e.g., adding validity checking, exception handling)
- h. specifying final hardware/software configuration for acquisition
- i. performing system and acceptance testing

5.2 Implementation Schedule

The schedule for implementation of the WWW Server has been made to mesh with the other NCC 98 activities. The schedule is shown in Figure 5-1. The Design Review for the WWW Server will be combined with the CCS Build 2 Design Review in February 1997.

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ID	Task Name	rter	3rd Quarter				1st Quarter			3rd Quarter			1st Quarter		
		5	7	9	11	1	3	5	7	9	11	1	3	5	
1	WWW Server														
2	System Engineering														
3	Evaluation of COTS products														
4	DT&T Hardware Selection														
5	OCR Hardware Selection														
6	Design														
7	Detailed Design and Development														
8	Design Review														
9	Implementation														
10	Implementation Activites														
11	Integration														
12	Integration Activities														
13	NCC 98 Build 2 Test														
14	Integration Test														
15	System Test														
16															

Section 6. Issues

6.1 "Freshness" of TUT Information

Because of the complexity required to compute the TUT information for flexible requests, the requirements and this specification only require that TUT information be calculated periodically as specified by the operator, or in special cases on operator command. It is desirable for the TUT information to be as fresh as possible; the SPSR development team should perform further analysis to determine if it is possible to keep the TUT information up to date with the schedule, and NCC operations should perform some analysis to determine how fresh the information should be, in case there must be a tradeoff between freshness and SPSR performance.

6.2 Contents of the Nascom Information

The contents of the Nascom Information, as shown in Table 4-2, is preliminary, pending review by Nascom. In particular:

- a. The data stream ID is an octal number placed in the Nascom 4800 Bit Block header by the MDMS, and is used to identify the type of data (e.g., real-time engineering data, tape recorder dump, etc.) flowing over that channel. It is assumed that this data item will not be used.
- b. Because there is a one-to-one mapping between the User Interface Channel and the Ground Terminal Port, it is redundant to include both.

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Abbreviations and Acronyms

BB	bit blocks
CCS	Communications and Control Segment
COTS	commercial off-the-shelf
CSS	Control and Status System
DB	database
DBMS	data base management system
DNS	domain name server
DT&T	Development, Test, and Training
FDF	Flight Dynamics Facility
FTP	File Transfer Protocol
GSFC	Goddard Space Flight Center
GT	ground terminal
HDRM	high data rate multiplexor
http	Hypertext Transfer Protocol
https	Hypertext Transfer Protocol for Secure Sockets Layer
I&A	Identification and Authentication
ICD	interface control document
IONET	IP operational network (Nascom)
IP	Internet Protocol
KDC	key distribution center
LAN	local area network
MAF	Multiple Access Forward

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MAR	Multiple Access Return
MDM	multiplexor demultiplexor
MIB	management information base
MO&DSD	Mission Operations and Data Systems Directorate
MOC	Mission Operations Center
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NCC	Network Control Center
NCCDS	Network Control Center Data System
ND	Networks Division
NEC	Nascom event cancel
NES	Nascom event schedule
NOC	Nascom Operations Center
NFW	NCC firewall
NPG	NCC Protocol Gateway
NRR	Nascom reconfiguration request
NSM	Network and System Manager
NTP	Network Time Protocol
OPM	operations message
OpsLAN	Operations Local Area Network
PM	preventive maintenance
RAM	random access memory
RFC	request for comment
SA	single access

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SDPF	Sensor Data Processing Facility
SDS	System Design Specification
SGL	space to ground link
SHO	scheduling order
SHTTP	Secure Hypertext Transfer Protocol
SMAF	S-band Multiple Access Forward
SMAR	S-band Multiple Access Return
SMP	System Management Policy
SMTP	Simple Mail Transport Protocol
SN	Space Network
SNMP	Simple Network Management Protocol
SPSR	Service Planning Segment Replacement
SRD	System Requirements Document
SRIS	System Resources and Infrastructure Segment
SRM	Schedule Result Message
SSL	Secure Sockets Layer
STDN	Spaceflight Tracking and Data Network
STGT	Second TDRSS Ground Terminal
TBD	To Be Determined
TBR	To Be Reviewed
TBS	To Be Supplied
TCP	Transmission Control Protocol
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System

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TFTP	Trivial File Transfer Protocol
TUT	TDRSS Unscheduled Time
UDP	User Datagram Protocol
WSC	White Sands Complex
WSGT	White Sands Ground Terminal
WWW	World Wide Web