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PROJECTS DIVISION**

**Satélite de Aplicaciones
Científicas-D (SAC-D)
Network Requirements Document**

Revision 1

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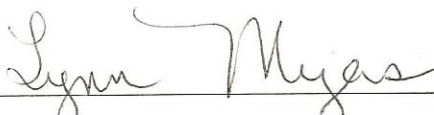
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Satélite de Aplicaciones Cientificas-D (SAC-D) Network Requirements Document

September 14, 2010

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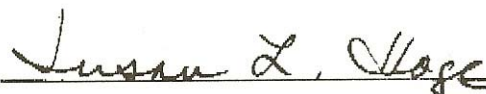


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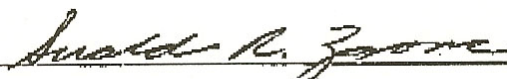


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450-NRD-SAC-D
Revision 1

Preface

This Network Requirements Document (NRD) defines the service requirements between the Satélite de Aplicaciones Científicas-D (SAC-D) Spacecraft, and the Near Earth Network (NEN) (formerly NGN) systems resources.

This document is under configuration management of the Goddard Space Flight Center (GSFC) Networks Integration Management Office (NIMO) Configuration Control Board (CCB) Code 450.1. This document will be updated by Documentation Change Notice (DCN) or complete revision. Proposed changes to this document should be submitted to the Code 450.1 CCB along with supporting material justifying the proposed change. Comments or questions concerning this document and proposed changes shall be addressed to:

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Section 1. Mission Description

1.1 Mission Overview

1.1.1

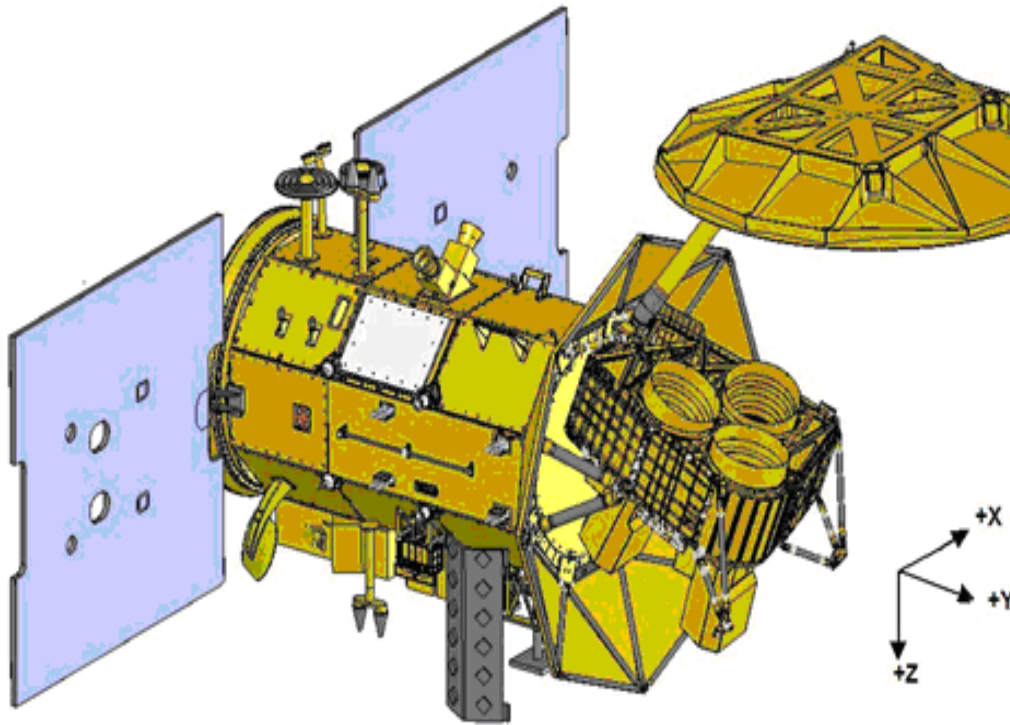
The Satélite de Aplicaciones Científicas-D (SAC-D) Mission is a partnership between the National Aeronautics and Space Administration (NASA) and Comisión Nacional de Actividades Espaciales (CONAE), the Argentine space agency, to plan, develop, collect, and return science data from an Earth-orbiting system.

1.1.2

Aquarius is one of eight payloads on the SAC-D Spacecraft. Aquarius, built and operated by NASA, is the primary instrument on SAC-D. The Aquarius Payload will make pioneering space-based measurements of Sea Surface Salinity (SSS) to characterize salinity variation and investigate the linkage between ocean circulation, the Earth's water cycle, and climate variability. The Project will generate global salinity maps on a monthly basis. (See Figure 1-1 for an illustration of the SAC-D Spacecraft.)

1.2 Mission Objectives

- a. Measurements of SSS to characterize salinity variation and investigate the linkage between ocean circulation, the Earth's water cycle, and climate variability.
- b. Measurement of rain rates, surface wind speeds, water vapor, and cloud liquid water over the ocean, which will enhance the results of the Aquarius measurements.
- c. Measurement of the physical parameters of the High Temperature Events (HTE) on the ground, caused by biomass fires and volcanic eruptions.
- d. Measurement of Sea Surface Temperature (SST).
- e. Measurement of the temperature and humidity profile of the troposphere and stratosphere.
- f. Measurement of sea ice concentration.
- g. Measurement of lightning, light intensity over urban areas, and polar auroras.
- h. Receive and store meteorological and environmental data generated by the ground based measurement systems for later transmission to Cordoba Ground Station (ETC) and distribution to the customer community.
- i. Validate a newly developed Global Positioning System (GPS) receiver for position, velocity, time determination, and an Inertial Reference Unit (IRU) to measure inertial angular velocity.



Aquarius and Other Instruments

Figure 1-1. SAC-D Spacecraft

- j. To detect micro meteoroids and orbital debris to understand kinetics of space damage and evaluate orbit debris population and its evolution.

1.3 Other Experiments

- a. Microwave Radiometer (MWR).
- b. New Infrared Sensor Technology (NIRST).
- c. High Sensitivity Camera (HSC).
- d. Data Collection System (DCS).
- e. Radio Occultation Sounder for Atmosphere (ROSA).
- f. Cosmic Radiation Effects and Orbital Debris and Micrometeoroids Detector (CARMEN).
- g. Technological Demonstration Package (TDP).

1.4 Mission Operations Concept

1.4.1 General

1.4.1.1

SAC-D will be launched on a Delta II 7320-10C no earlier than April 1, 2011. The control center is located at Cordoba, Argentina. The primary ground station is the ETC.

1.4.1.2

The SAC-D mission duration is 5 years; the Aquarius portion is 3 years.

1.4.1.3

The Near Earth Network (NEN) (formerly NGN) will provide services during Launch, spacecraft, and instrument checkout. For the remainder of the mission, NEN will provide services for cold sky calibrations (two passes monthly) and orbit maneuvers (five passes per month). NEN will provide backup and emergency services as required. See Figure 1-2 for the NIMO Network Overview for SAC-D.

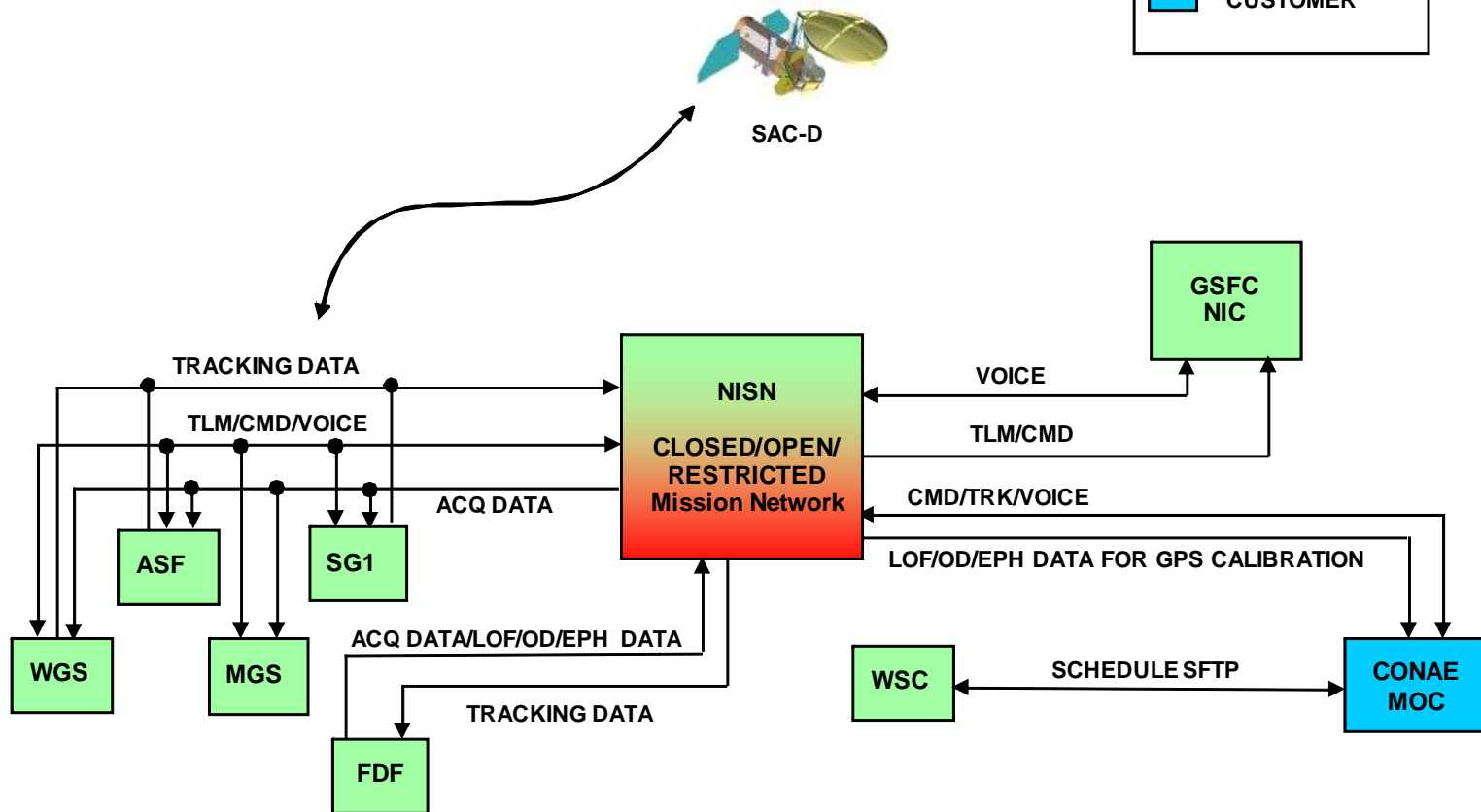
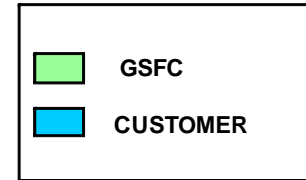
1.4.2 Launch Hold Criteria

The following NASA Network resources are required for Launch:

- a. The ground terminal is required to be operational and ready to provide services for the SAC-D Satellite:
 1. Wallops Ground Station (WGS), Wallops Island, VA, Svalbard (SG1), Norway, or Alaska Satellite Facility (ASF), AK.
 2. Ability to throughput commands, telemetry, and angle data.
 3. Ability to receive and process updated schedules and Improved Interrange Vectors (IIRV).
- b. McMurdo Ground Station (MGS), Antarctica is desired to be operational and to provide commands and telemetry to the SAC-D Satellite.
- c. The Flight Dynamics Facility (FDF) is required to be able to receive spacecraft separation vectors from United Launch Alliance (ULA) and update the NEN and Data Services Management Center (DSMC) with updated IIRVs.
- d. The DSMC is required to be able to receive updated IIRVs from FDF and forward to MGS/ASF/WGS/SG1.
- e. The Mission Operations Center (MOC), Cordoba, Argentina, is required to have one command console in the MOC declared operational for Launch.
- f. Data and voice communications circuits between the MOC and the NEN are required to be operational.

- g. All the listed SAC-D communication links (voice and/or phone) are required to be operational:
1. Spacecraft Test Conductor at Building 836 to Spacecraft Manager at Mission Director Center (MDC).
 2. MOC at Cordoba, Argentina to Spacecraft Mission Director at MDC.
 3. Spacecraft Mission Director at MDC to NASA Launch Manager at MDC.

S-band NEN:
 Uplink: 4 kbps (BPSK/PM)
 Downlink: 80 kHz (BPSK/PM)



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Figure 1-2. NIMO Network Overview for SAC-D

1-5/1-6

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Section 2. Network Services Overview

2.1 Near Earth Network

2.1.1 General

The SAC-D will use the ETC in Argentina, as the primary command and control site. The NEN, SG1, ASF, and WGS will be used to provide real-time spacecraft command, housekeeping, telemetry, and tracking services during Launch and Early Orbit Phase (LEOP), emergencies, calibrations, and maneuver services. MGS will be used to provide real-time spacecraft command, housekeeping, and telemetry services.

- a. MGS, located at Antarctica, is one of the four backup NEN stations for the SAC-D real-time command uplink and telemetry downlink. MGS will provide S-band telemetry data to provide services for the SAC-D LEOP, emergencies, calibrations, and maneuver services.
- b. ASF, located at Fairbanks, AK, is one of four backup NEN stations for SAC-D real-time command uplink and telemetry downlink. ASF will provide tracking (first 60 days), S-band telemetry data to provide services for the SAC-D LEOP, emergencies, calibrations, and maneuver services.
- c. WGS is located at the NASA Wallops Flight Facility (WFF) on the Eastern Shore of VA. WGS is one of four backup NEN stations for SAC-D real-time command uplink and telemetry downlink. WGS will provide tracking (first 60 days), S-band telemetry data to provide services for the SAC-D LEOP, emergencies, calibrations, and maneuver services.
- d. SG1, located at Svalbard, Norway, is one of four backup NEN stations for SAC-D real-time command uplink and telemetry downlink. SG1 will provide tracking, S-band telemetry data to provide services for the SAC-D LEOP, emergencies, calibrations, and maneuver services.

2.1.2 Requirements

- a. LEOP: The postlaunch checkout of the SAC-D Spacecraft and Payload will proceed in three phases. The requirements for NEN service differ with each phase as follows:
 1. Stage 1 - Launch day to L+2 days. NEN services are required for all available passes with a 5-minute minimum.
 2. Stage 2 - From L+3 days to L+24 days. This will be a period of spacecraft checkout. NEN services are required for one pass per orbit.
 3. Stage 3 - From L+25 days to L+45 days. This will be a period of initial activation and checkout of the instruments. NEN services are required for all available passes with a 5-minute minimum.

NOTE

On or about November 15, 2010 MGS will be closed for maintenance for approximately 4 months.

b. On-orbit Operations.

1. After the LEOP and checkout activities are complete, the spacecraft will transition to routine operations. The routine operations phase will rotate through two distinct activities. The SAC-D mission duration is 5 years; the Aquarius portion of the mission is 3 years.
2. Cold Sky Calibration. Two passes per Cold Sky maneuver (a pitch maneuver of the SAC-D Spacecraft; pitch forward to 180 degrees, hold for <15 minutes, and pitch back). The two passes would cover one pass prior to the maneuver and one pass after. Cold Sky maneuvers are planned once per month for the duration of the mission of 5 years.
3. Orbit Maneuvers. Five passes per Orbit maneuver for the duration of the SAC-D mission. There will be one maneuver per month.
4. Contingency Services. To be scheduled as needed (i.e., one pass/orbit) for the life of the SAC-D Mission.
5. Monthly Proficiency Services. To be scheduled (i.e., one pass each station/month) during any month where the NEN is not scheduled.

NOTE

Proficiency passes are required to guarantee services.

- c. For the NEN mission phase requirements refer to Table 2-1.

2.1.3 NEN Services

2.1.3.1 Data Acquisition

The NEN will provide S-band command and telemetry service for the critical events, (i.e., Cold Sky Calibration and Orbit maneuvers). In the event neither maneuver is performed during a calendar month, proficiency passes will be scheduled for each NEN station.

2.1.3.2 Telemetry

The SAC-D S-band transmitters will have a rate of 4-kbps Nonreturn to Zero-Mark (NRZ-M) Biphase Shift Key (BPSK)/PM on 80-kHz Subcarrier. Refer to Table 2-2.

2.1.3.3 Commanding

The SAC-D S-band receivers will be configured for 4-kbps uplink (BPSK/PM on 16-kHz Subcarrier). Refer to Table 2-3.

Table 2-1. NEN Mission Phase Requirements

Phase	Period (e.g., L+30 days)	No. of Contacts Required (Min /Max.) (per day)	Contact Duration Required (Min./Max.) (minutes)	Total Contact Time (minutes per day)
Testing	As Required	As Required	As Required	
LEOP Stage 1	48 hours	2 days x 14~ orbits/day x 3 contacts/orbit	5/10 mins	420
Ops Checkout & LEOP Stage 2	L+3 days to L+24 days	22 days x 14~ orbits/day x 1 contact/orbit	10 mins	140
Ops Checkout & LEOP Stage 3	L+25 days to L+45 days	21 days x 14~ orbits/day x 2.4 contacts/orbit	5/10 mins	336
Proficiency	Life of Mission	As Required	As Required	
Contingency	Life of Mission	As Required	As Required	
Maneuvers	1 per month	5 contacts	10 mins	50
Cold Sky Calibrations	1 per month	2 contacts (1 contact before maneuver, 1 contact after)	15 mins	30
End of Mission	L+5 years	As Required	As Required	

NOTE

Stages may be extended in case of any delay during LEOP up to L+60 days.

Table 2-2. SAC-D Transmit Characteristics for the NEN

Service	Data Rate	Modulation	Data Format	Antenna
NEN Downlink	4 kbps	BPSK/PM At 1.5 rad with 80-kHz Subcarrier	NRZ-M	Omni (RHCP)

Table 2-3. SAC-D Receive Characteristics for the NEN

Service	Modulation	Data Rate	Data Format	Antenna
NEN Uplink	BPSK/PM At 1.5 rad with 16-kHz Subcarrier	4 kbps	NRZ-M	Omni (RHCP)

2.1.3.4 Data Formatting and Transfer

Real-time command and telemetry data will be transported between the MOC and the NASA ground sites in Internet Protocol (IP) by the NASA Integrated Services Network (NISN).

2.1.3.5 Commanding

Commanding may be performed during any contact that is scheduled and executed.

2.1.3.6 Tracking

Tracking services will be required for the first 60 days by the FDF. After the first 60 days, ETC will assume all Flight Dynamics related tasks. NEN (except MGS) will provide angle and Two-way Doppler (TWD) data in Universal Tracking Data Format (UTDF) post pass to the FDF via File Transfer Protocol (FTP).

2.1.3.7 Scheduling

The MOC will exchange schedule information with the DSMC/Near Earth Network Scheduling Office (NENSO).

2.1.3.8 Ephemeris Data

- a. Launch to L+60 days. NENSO will use IIRVs provided by FDF, for all ephemeris data sent to the ground station.
- b. After L+60 days:
 1. Prime. NENSO will use TLEs provided by MOC, for all ephemeris data sent to the ground station.
 2. Backup. NENSO will use TLEs provided by the United States Strategic Command (USSTRATCOM) (Space Track) bulletin board, for all ephemeris data sent to the ground stations.

NOTE

Because the USSTRATCOM (Space Track) does not guarantee the timeliness of the information on their bulletin board, all NEN services relying on TLEs are on a “best-effort” basis.

2.2 Space Network – Not Applicable

2.3 Deep Space Network – Not Applicable

2.4 Laser Range Network – Not Applicable

2.5 Flight Dynamics

2.5.1 General

FDF will provide Orbit Determination (OD), Launch, and definitive orbit solution data for the SAC-D Spacecraft. The Goddard Space Flight Center (GSFC) organization is the Navigation Mission Design Branch (Code 595).

2.5.2 Requirements

During LEOP, FDF will provide trajectory and orbit analysis, orbit prediction, and definitive orbit solution data for use in GPS calibration. FDF will receive and process all SAC-D tracking data from NEN resources, including NEN angle data and TWD data. FDF service is required for a period of 60 days following Launch.

2.5.3 Services

2.5.3.1 Launch Rehearsals

FDF will participate in two Launch rehearsals (each rehearsal runs for 1 week). The Launch rehearsals will be scheduled during the period between L-30 days to L-7 days.

2.5.3.2 Tracking Data Evaluation

FDF provides standard prelaunch and Launch day Tracking Data Evaluation (TDE) services.

2.5.3.3 Launch Services

FDF will provide an update of the initial acquisition data to the NEN (MGS, SG1, ASF, and WGS) and MOC based on the SAC-D Launch Vehicle (LV) separation vector. Launch day ephemeris data are updated based on OD, which are typically done at Sep+3 and Sep+5 hours (depending on the Launch day tracking profile).

2.5.3.4 Orbit Determination

- a. FDF will provide OD services during the first 60 days of on-orbit activity, including acquisition of tracking data from ground stations, production of predicted ephemeris data sets, and distribution of ephemeris data to ground system schedulers and the MOC.
- b. Orbit solutions will be determined using NEN angles and TWD tracking data. FDF will provide OD services through L+60 days. OD services include orbit prediction and definitive orbit solution data. It will be the CONAE's task to compare the GPS state vector to FDF solution and to calculate the bias in their GPS measurement.
- c. FDF will provide OD daily.

2.5.3.5 Ephemeris Updates

- a. IIRV updates based on OD are provided by the FDF to the NEN through standard means and to the MOC via SFTP server and the FDF "bulletin board" or internet web site. FDF will provide this service from Launch through L+60 days.

- b. During nominal operations, the MOC will provide SAC-D postburn predictions to the FDF via an SFTP Server and e-mail before the maneuver.

2.6 NASA Integrated Services Network

For SAC-D, NISN provides data and voice services between the elements of the NEN and the customer’s facilities. NISN is managed from Marshall Space Flight Center (MSFC), with an organization at GSFC for the Mission Network services provided to their customers. NISN will provide a single mission critical circuit between GSFC and Cordoba.

2.7 Mission Integration and Testing

Mission Integration and Testing (I&T) will include Compatibility testing, End-to-End (ETE) tests, Operational Readiness Tests (ORT), Mission Readiness Tests (MRT), etc. The Compatibility Test will commence December 7-11, 2009, at the Radio Frequency (RF) Simulations Operations Center (SOC) facilities to include an Engineering Model of the Transponder. Table 2-4 provides a tentative schedule for testing activities commencing winter 2009, through Launch. All testing activities will be in accordance with the Network Test Plan (NTP) for the SAC-D Mission.

Table 2-4. Networks SAC-D Test Schedule

Test Event	Date
Compatibility Test Van (CTV)	December 2009
Connectivity and Data Flow Testing	January 2010
ETE Testing	March 2010 to June 2010
Weekly Proficiency Tests	July 2010 to Launch
Mission Dress Rehearsal	April 2011

2.8 Other Networks Services – Not Applicable

Section 3. Networks Requirements Table

3.1 Near Earth Network		
NRD #	3.1.1 General	Source
3.1.1.1	NEN Services: NEN shall provide real-time spacecraft command, housekeeping telemetry, and tracking services during LEOP, emergencies, calibrations, and maneuver services.	L2B-AS-a-1340 L2B-AS-a-1737
3.1.1.2	NEN Stations: NEN shall utilize MGS, SG1, ASF, and WGS to provide services for the SAC-D Spacecraft.	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.1.2 Tracking	Source
3.1.2.1	Tracking Services: NEN stations (except MGS) shall collect angles and TWD tracking data during each contact and transmit the data post pass to the FDF through L+60 days.	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.1.3 Telemetry	Source
3.1.3.1	Telemetry Services: NEN shall provide S-band telemetry services. The S-band telemetry rate shall be 4 kbps and the downlink modulation scheme is BPSK/PM at 1.5 rad with 80-kHz Subcarrier.	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.1.4 Command	Source
3.1.4.1	Command Services: NEN shall provide S-band command services. The S-band command rate shall be 4 kbps and the uplink modulation scheme is BPSK/PM at 1.5 rad with 16-kHz Subcarrier.	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.1.5 Data Distribution & Storage	Source
3.1.5.1	Data Distribution: NEN shall format all command and telemetry data and transport the data between the MOC and the NASA ground stations over the NISN circuit.	L2B-AS-a-1340 L2B-AS-a-1737

3.1.5.2	Storage Services: NEN shall store data for playback up to 30 days.	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.1.6 Scheduling	Source
3.1.6.1	Scheduling Services: The NENSO shall receive schedule requests from the MOC via SFTP (SSH File Transfer Protocol). Each side shall have a SFTP server where the other side can put its new messages. E-mail shall be available as a backup alternative.	L2B-AS-a-1340 L2B-AS-a-1737
3.1.6.2	Ephemeris Data: <ul style="list-style-type: none"> a. NENSO shall have the capability to pull TLEs from USSTRATCOM. b. NENSO shall have the capability to receive IIRVs from FDF. c. NENSO shall have the capability to receive TLEs from MOC 	L2B-AS-a-1340 L2B-AS-a-1737
3.2 Space Network – Not Applicable		
3.3 Deep Space Network – Not Applicable		
3.4 Laser Ranging Requirements – Not Applicable		
3.5 Flight Dynamics		
NRD #	3.5.1 Summary	Source
3.5.1.1	FDF Services Summary: <ul style="list-style-type: none"> a. FDF shall provide trajectory, orbit analysis, and orbit prediction to NEN and MOC. b. FDF shall provide trajectory, orbit analysis, and orbit prediction to the MOC for use in GPS calibration, for L+60 days. c. FDF shall provide services as needed and requested by SAC-D for the life of the mission. 	L2B-AS-a-1340 L2B-AS-a-1737

NRD #	3.5.2 Prelaunch/Mission/Planning	Source
3.5.2.1	Prelaunch Services: FDF shall participate in two launch rehearsals. The 1-week rehearsals shall be scheduled between L-30 days to L-7 days.	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.5.3 Prelaunch	Source
3.5.3.1	Tracking Data Evaluation: FDF shall provide standard prelaunch TDE services.	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.5.4 Launch	Source
3.5.4.1	<p>Launch Services:</p> <ul style="list-style-type: none"> a. FDF shall provide an update of the initial acquisition data to NEN (SG1, MGS, ASF, and WGS) and MOC based on the SAC-D LV separation vector provided by the Launch facility. b. FDF shall provide updated ephemeris data based on OD, which are typically done at L+3 and L+5 hours 	L2B-AS-a-1340 L2B-AS-a-1737
3.5.4.2	Tracking Data Evaluation: FDF shall provide standard Launch TDE services.	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.5.5 Early Orbit and Instrument Checkout	Source
3.5.5.1	OD Services: FDF shall receive NEN TWD and angle data from the NEN and shall provide orbit solutions to MOC and NEN. OD services shall include orbit prediction and definitive orbit solution data.	L2B-AS-a-1340 L2B-AS-a-1737
3.5.5.2	Acquisition Data Services: FDF shall provide acquisition data for all NEN services during LEOP from Launch to L+60 days.	L2B-AS-a-1340 L2B-AS-a-1737
3.5.5.3	Tracking Data Delivery: FDF shall receive tracking data post pass from NEN.	L2B-AS-a-1340 L2B-AS-a-1737

NRD #	3.5.6 Normal Operations	Source
3.5.6.1	Acquisition Data Services: FDF shall provide acquisition data to NEN for maneuvers.	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.5.7 Contingency Services – Not Applicable	Source
NRD #	3.5.8 Maneuver Services – Not Applicable	Source
3.6 NASA Integrated Services Network		
NRD #	3.6.1 General	Source
3.6.1.1	NISN Services Summary: NISN shall provide data and voice services between the elements of NEN and the SAC-D facilities at CONAE.	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.6.2 Data Communications	Source
3.6.2.1	NEN Services: NISN shall transport all command and telemetry data utilizing the Mission Network between the NEN stations and CONAE (through GSFC).	L2B-AS-a-1340 L2B-AS-a-1737
NRD #	3.6.3 Voice Communications	Source
3.6.3.1	Voice Services (GSFC/CONAE): NISN shall provide voice circuits to connect GSFC and CONAE (MOC).	L2B-AS-a-1340 L2B-AS-a-1737
3.7 Mission Integration and Testing		
NRD #	3.7.1 RF Compatibility Testing	Source
3.7.1.1	RF Compatibility Test: NIMO shall conduct RF compatibility testing at the Compatibility Test Lab utilizing an engineering unit of the transponder.	Derived
NRD #	3.7.2 NOM Services	Source
3.7.2.1	NOM Launch Day Responsibilities: The Network Operations Manager (NOM) and Mission Commitment Engineer (MCE) shall be on-console from L-5 hours to the time FDF is able to provide an Orbit Solution.	Derived
3.8 Other Network Services – Not Applicable		

Abbreviations and Acronyms

Acronym	Definition
ACQ	Acquisition
ASF	Alaska Satellite Facility
BPSK	Biphase Shift Keyed
CARMEN	Cosmic Radiation Effects and Orbital Debris and Micrometeoroids Detector
CCB	Configuration Control Board
CCR	Configuration Change Request
CMD	Command
CMO	Configuration Management Office
CONAE	Comisión Nacional de Actividades Espaciales
CTV	Compatibility Test Van
DCN	Documentation Change Notice
DCS	Data Collection System
DSMC	Data Services Management Center
ESC	NASA GSFC Exploration and Space Communications Projects Division, Code 450
ETC	Cordoba Ground Station
ETE	End-to-End
FDF	NASA GSFC Flight Dynamics Facility
FTP	File Transfer Protocol
GPS	Global Positioning System
GSFC	NASA Goddard Space Flight Center
HSC	High Sensitivity Camera
HTE	High Temperature Events
IIRV	Improved Interrange Vector
IP	Internet Protocol
IRU	Inertial Reference Unit

Acronym	Definition
I&T	Integration and Testing
L	Launch
LEOP	Launch and Early Orbit Phase
LOF	Local Oscillator Frequency
LV	Launch Vehicle
MCE	Mission Commitment Engineer
MDC	Mission Director Center
MGS	McMurdo Ground Station, Antarctica
MOC	Mission Operations Center, located at Cordoba, Argentina
MRT	Mission Readiness Test
MSFC	NASA Marshall Space Flight Center
MWR	Microwave Radiometer
NASA	National Aeronautics and Space Administration
NEN	Near Earth Network
NENSO	Near Earth Network Scheduling Office
NGIN	Next Generation Integrated Network
NIC	Network Integration Center
NIM	Networks Integration Manager
NIMO	NASA GSFC Networks Integration Management Office, Code 450.1
NIRST	New Infra-red Sensor Technology
NISN	NASA Integrated Services Network
NOM	Network Operations Manager
NRD	Networks Requirements Document
NRZ-M	Nonreturn to Zero-Mark
NTP	Network Test Plan
OD	Orbit Determination
ORT	Operational Readiness Test
PM	Phase Modulation

Acronym	Definition
RF	Radio Frequency
RHCP	Right-hand Circular Polarization
ROSA	Radio Occultation Sounder for Atmosphere
SAC-D	Satélite d'Aplicaciones Cientificas-D
SG1	Svalbard, Norway
SOC	Simulation Operations Center
SSS	Sea Surface Salinity
SST	Sea Surface Temperature
TBD	To Be Determined
TDE	Tracking Data Evaluation
TDP	Technological Demonstration Package
TLE	Two-line Element
TLM	Telemetry
TRK	Tracking
TWD	Two-way Doppler
USSTRATCOM	United States Strategic Command (Space Track)
UTDF	Universal Tracking Data Format
WFF	Wallops Flight Facility
WGS	Wallops Ground Station, Wallops Island, VA