450-NOD/HS

450/EXPLORATION AND SPACE COMMUNICATIONS PROJECTS DIVISION

Network Operations Directive for Human Space Flight Network Support

Draft General Review Copy

Revision 4

Effective Date: TBS

Expiration Date: TBS

National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

CHECK THE NEXT GENERATION INTEGRATED NETWORK (NGIN) AT:
https://code450ngin.gsfc.nasa.gov/
PRIOR TO USE TO VERIFY THAT THIS IS THE CORRECT VERSION

Pre-Decisional, For Internal NASA Use Only

Network Operations Directive for Human Space Flight Network Support

TBS

Concurrence by:

_____ Date_____

James A. Bangerter, Human Space Flight Network Director
Network Integration Management Office, Code 450.1
Goddard Space Flight Center, Greenbelt, MD 20771
Telephone: (301) 286-7306; E-mail: James.A.Bangerter@nasa.gov

Concurrence by:

_____ Date_____

Joseph M. Aquino, Space Communications Integration Office Manager
Space Communications Integration Office, Code DD13
Johnson Space Center, 2101 NASA Road 1, Houston, TX 77058
Telephone: (281) 483-4033; E-mail: Joseph.M.Aquino@nasa.gov

Approved by:

_____ Date_____

Scott A. Greatorex, Chief, Networks Integration Manager
Networks Integration Management Office, Code 450.1
Goddard Space Flight Center, Greenbelt, MD 20771
Telephone: (301) 805-6354; E-mail: Scott.A.Greatorex@nasa.gov

Approved by:

_____ Date _____

Paul S. Hill, Director
Mission Operations Directorate Code DA
Johnson Space Center, 2101 NASA Road 1,Houston, TX 77058
Telephone: (281-483-3321; E-mail: Paul.S.Hill@nasa.gov

Approved by:

_____ Date_____

Gary A. Morse, Mission Communications Manager
Space Communication and Navigation Program Code XXX
300 E Street Southwest, Washington, DC 20024-3210
Telephone: (202-358-0504); E-mail: gary.a.morse@nasa.gov

This document supersedes the *Network Operations Directive for Human Space Flight Network Support*, 450-NOD/HS, Revision 3 dated December 18, 2009. Please discard all previously issued copies.

Goddard Space Flight Center
Greenbelt, Maryland

Preface

This Human Space Flight (HSF) Network Operations Directive (NOD) provides the management structure and operational responsibilities of the National Aeronautics and Space Administration (NASA) centers supporting HSF Network activities. For the purpose of this document, Human Space Flight is defined as vehicles or systems being developed, tested, or used to support Human Exploration Operations (HEO). This document requires Government review and approval prior to acceptance and use.

This document is under configuration management of the 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. Use the Document Change Request form shown in the rear of this document to submit suggested changes in a timely manner. This form is available electronically from the GSFC Human Space Flight (HSF) Documentation web site on the internet at: http://scp.gsfc.nasa.gov/hsfnsg/hsd.html. 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:

Human Space Flight Network Director
Networks Integration Management Office
GSFC Code 450.1
NASA Goddard Space Flight Center
Greenbelt, Maryland 20771
E-mail: James.A.Bangerter@nasa.gov

cc: GSFC Spaceflight Mission Manager
E-mail: smmconsole@ncc-comm.gsfc.nasa.gov

Developed by: Robert R. Marriott
NOIT Group Manager
E-mail: Robert.R.Mariott@nasa.gov

Prepared by: Earl H. Daniel
HSF/SCNS, Aerospace Engineer
E-mail: Earl.Daniel.contractor@exelisinc.com

This document may be downloaded from the Exploration and Space Communications Projects Division (ESC) library at https://code450ngin.gsfc.nasa.gov/. If you do not have direct access to the library, you may obtain the document from the Code 450.1 Configuration Management Office (CMO) or the mission contractor documentation office.

Change Information Page

List of Effective Pages	
Page Number	**Issue**
Title	Revision 4
Signature Page	Revision 4
Preface	Revision 4
Change Information Page	Revision 4
DCN Control Sheet	Revision 4
ix through xiii/xiv	Revision 4
1-1 through 1-9/1-10	Revision 4
2-1 through 2-20	Revision 4
3-1 through 3-18	Revision 4
4-1 through 4-6	Revision 4
5-1/5-2	Revision 4
6-1 through 6-8	Revision 4
7-1 through 7-6	Revision 4
8-1 and 8-2	Revision 4
AB-1 through AB-12	Revision 4

Document History			
Document Number	**Status/Issue**	**Publication Date**	**CCR Number**
STDN No. 508	Original Revision 1 Revision 2 Revision 3 Revision 4 Revision 5	May 1979 January 1981 February 1985 February 1987 October 1988 December 1990	
501-508	Revision 6 Revision 7 (Retired 9/00)	February 1993 April 1995	
450-NOD/HS	Original Revision 1 Revision 2 Revision 3 Revision 4	September 2000 August 2004 July 2006 December 18, 2009 December	N/A 451/747 451/1212 450.1/558 450.1/XXX

DCN Control Sheet

DCN Number	Date/Time Group (Teletype Only)	Month/Year	Section(s) Affected	Initials

Contents

Preface ..... **iii**

Section 1. Introduction **1-1**

1.1 Purpose and Scope 1-1
1.1.1 General 1-1
1.1.2 Document Handling 1-1
1.2 Change Authorization 1-1
1.3 Overview 1-1
1.3.1 Document Organization 1-1
1.3.2 Human Exploration Operations Mission Directorate 1-2
1.4 Human Space Flight Network Management 1-4
1.4.1 Human Exploration Operations Mission Directorate 1-5
1.4.2 NASA Mission Commitment Manager 1-5
1.4.3 Network Integration Management Office 1-5
1.4.4 Space Communications Integration Office 1-5
1.4.5 IT Infrastructure Integration Program Communications Service Office 1-5
1.5 Related Documents and Web Sites 1-6
1.5.1 Documents 1-6
1.5.2 Web Sites 1-7
1.6 HEO Mission Services Funding 1-8
1.7 Associate Contractor Agreements 1-8
1.8 Configuration Management Process 1-8

Section 2. Human Space Flight Integrated Network **2-1**

2.1 Overview 2-1
2.2 JSC Space Communications Integration Office Structure 2-1
2.2.1 Interactions 2-1
2.2.2 Primary Role 2-1
2.2.3 Reports/Information Exchange 2-4
2.3 Network Support Group 2-4
2.3.1 Network Director 2-5
2.3.2 Operations Readiness Review 2-5
2.3.3 HSF Communications Working Group 2-6
2.3.4 Network and Communications Analysis and Integration Team 2-6

2.4 Goddard Space Flight Center 2-7
2.4.1 General 2-7
2.4.2 HSF Network Director 2-7
2.4.3 Network Integration Center 2-8
2.4.4 Space Network 2-9
2.4.5 Near Earth Network HSF Operations 2-10
2.4.6 Deep Space Network 2-11
2.4.7 Flight Dynamics Facility 2-12
2.4.8 Simulation Operations Center 2-12
2.4.9 Compatibility Test Laboratory 2-12
2.5 Johnson Space Center 2-12
2.5.1 Network Operations Integration Task 2-12
2.5.2 Mission Control Center 2-13
2.5.3 Electronics Systems Test Laboratory 2-13
2.5.4 JSC- Software Development Integration Laboratory 2-13
2.5.5 Exploration Development Laboratory Houston 2-14
2.6 Communications Service Office 2-14
2.6.1 CSO Mission Operations 2-15
2.6.2 HSF Communications Working Group 2-17
2.6.3 Mission Communications Working Group 2-17
2.7 Eastern Range / Western Range 2-17
2.7.1 Cape Canaveral Air Force Station 2-18
2.7.2 CCAFS – Hanger AE 2-18
2.7.3 CCAFS – XY 2-18
2.8 Kennedy Space Center 2-18
2.8.1 Communications Distribution and Switching Centers 2-19
2.8.2 21st Century Space Launch Complex 2-19
2.8.3 Commercial Crew Program 2-19
2.8.4 Operations and Checkout Facility 2-19
2.9 Marshall Space Flight Center 2-19
2.9.1 Huntsville Operations Support Center 2-19
2.10 Glenn Research Center 2-20
2.11 Langley Research Center (LRC) – TBS 2-20
2.12 Dryden Flight Research Center Ground Station 2-20

Section 3. International Space Station Program 3-1
3.1 Overview 3-1
3.1.1 General 3-1
3.1.2 Mission Description 3-1
3.1.3 United States On-orbit Segment 3-2
3.1.4 Visiting Vehicles 3-3

3.2 NASA Centers Supporting the ISS Program 3-6
3.2.1 Johnson Space Center 3-6
3.2.2 JSC Scheduling – HSF Network for ISS 3-9
3.2.3 Goddard Space Flight Center 3-11
3.2.4 Kennedy Space Center - TBS 3-15
3.2.5 Marshall Space Flight Center 3-15
3.2.6 Glenn Research Center 3-18
3.2.7 Eastern Range 3-18

Section 4. Multi-Purpose Crew Vehicle 4-1
4.1 Overview 4-1
4.1.1 General 4-1
4.2 Exploration Flight Test 4-1
4.2.1 General 4-1
4.2.2 MPCV Mission Phases 4-1
4.3 Goddard Space Flight Center – MPCV 4-5
4.3.1 General 4-5
4.3.2 Integration Process 4-5
4.4 Johnson Space Center (JSC) – TBS 4-6
4.5 Kennedy Space Center – MPCV, TBS 4-6
4.6 Marshall Space Flight Center – MPCV, TBS 4-6
4.7 Eastern Range – MPCV, TBS 4-6
4.8 Glenn Research Center – MPCV, TBS 4-6
4.9 Jet Propulsion Laboratory (JPL) – MPCV 4-6
4.9.1 Network Working Group 4-6
4.9.2 Deep Space Network – MPCV, TBS 4-6

Section 5. Commercial Crew Program 5-1
5.1 Overview 5-1
5.1.1 General 5-1

Section 6. Network Planning and Coordination 6-1
6.1 General 6-1
6.2 Group and Organization Descriptions 6-6
6.2.1 Advanced Communications Working Group 6-6
6.2.2 Ascent/Entry Flight Techniques Panel 6-6
6.2.3 Automated Support Requirements System 6-6
6.2.4 Ground Segment Control Board 6-6
6.2.5 HSF Communications Working Group 6-7
6.2.6 Mission Communications Working Group 6-7
6.2.7 Network and Communications Analysis and Integration Team 6-7

6.2.8 Network Support Group 6-7
6.2.9 Program Requirements Control Board 6-8
6.2.10 Security Analysis Response Team 6-8
6.2.11 Technical Interchange Meetings 6-8

Section 7. Requirements Management 7-1
7.1 Universal Documentation System 7-1
7.2 Automated Support Requirements System 7-1
7.3 Documentation 7-1
7.3.1 General 7-1
7.3.2 UDS Level 1 7-4
7.3.3 UDS Level 2 7-5
7.3.4 UDS Level 3 7-5
7.3.5 Network Program Requirements Document 7-5

Section 8. Readiness Reviews 8-1
8.1 General 8-1
8.2 Operational Readiness Review at GSFC 8-1
8.3 JSC/MOD FRR 8-1
8.4 Stage Operations Readiness Review 8-1
8.5 KSC Launch Readiness Review 8-2
8.6 Test Flight Readiness Review (TFRR) 8-2
8.7 NASA HEO Flight Readiness Review 8-2

Abbreviations and Acronyms AB-1

List of Figures

Figure 1-1. Human Exploration Operations Programs and Projects 1-3
Figure 1-2. NASA Centers/ DoD Elements Providing Mission and Data Services to HEO 1-4
Figure 2-1. Human Space Flight Integrated Network Structure Supporting Human Exploration Operations 2-2
Figure 2-2. SCIO Structure Supporting HEO / HSF 2-3

Figure 2-3. SCIO Integration of HEO / HSF Services 2-4
Figure 2-4. GSFC Structure for Providing Mission and Data Services to the HEO 2-8
Figure 2-5. Example of the TDRS Constellation Supporting HSF 2-10
Figure 2-6. CSO Data Service Office Management Structure for Supporting HEO/HSF Network Operations Activities 2-15
Figure 3-1. JSC SCIO Management Structure for ISSP 3-7
Figure 3-2. JSC SCIO Operational Interface Structure Supporting the ISSP 3-8
Figure 3-3. JSC – Network Scheduling – ISS 3-10
Figure 3-4. GSFC Structure for Supporting the ISSP 3-12
Figure 3-5. MSFC Operational Organization Supporting the ISS 3-16
Figure 3-6. MSFC Operational Structure Supporting the ISS .....
Figure 4-1. MPCV/EFT-1 – Mission Support Requirement Development Process 4-2
Figure 4-2. Integration of HSF Services for MPCV / EFT-1 4-3
Figure 4-3. EFT-1 Mission Operations Phase 4-5
Figure 6-1. Network Planning and Coordination of HEO Support 6-1
Figure 6-2. Network Planning and Coordination Supporting ISS 6-2
Figure 6-3. Network Planning and Coordination Supporting COTS / CRS 6-3
Figure 6-4. Network Planning and Coordination Supporting MPCV 6-4
Figure 6-5. Network Planning and Coordination Supporting Commercial Crew Program 6-5
Figure 7-1. Requirements Management Structure Supporting the HSF Program 7-1
Figure 7-2. Documentation Structure Supporting the HEO 7-2
Figure 7-3. Documentation Flow Diagram for the MPCV 7-2
Figure 7-4. Documentation Flow Diagram for ISS 7-3
Figure 7-5. Documentation Flow Diagram for Commercial Crew 7-4

List of Tables

Table 3-1. HSF Network ISS VV Direct Link Services 3-4
Table 3-2. HSF Network ISS VV, USOS, MCC-H Services 3-6

Section 1. Introduction

1.1 Purpose and Scope

1.1.1 General

This Human Space Flight (HSF) Network Operations Directive (NOD) is written to formalize working relationships and to provide a general understanding of the management and operational responsibilities of the National Aeronautics and Space Administration (NASA) centers and organizations providing support to the HSF Program. Human Space Flight (HSF) is defined as vehicles or systems being developed, tested, or used to support Human Exploration Operations (HEO). These include the International Space Station (ISS), Multi-Purpose Crew Vehicle (MPCV) – Exploration Flight Test (EFT), ISS Visiting Vehicles (VV) such as Commercial Cargo, International Partner Cargo Carriers, Commercial Crew Vehicles as well as Space Launch System (SLS), Mission Control Center (MCC) and Network Communications Training Systems. This document is not intended to provide detailed operational procedures on how the HEO Directorate programs and projects are supported. That level of detail is provided in the Network Operations Support Plans (NOSP) for each HEO Project. This document provides the framework that defines the Human Space Flight Integrated Network, Project interfaces, and Network Operations Management Structure.

1.1.2 Document Handling

This document does not contain technical data whose export is restricted by the Arms Export Control Act and International Traffic in Arms Regulation (ITAR) or the Export Administration. This document does not contain Sensitive But Unclassified (SBU) information.

1.2 Change Authorization

The baseline and any changes to this document require approval of the Mission Operations Directorate (MOD) Space Communications Integration Office (SCIO) at the Johnson Space Center (JSC), and the Goddard Space Flight Center (GSFC) Network Director (ND). Changes to this document will be made by Documentation Change Notice (DCN) or by complete revision.

1.3 Overview

1.3.1 Document Organization

In order to simplify the arrangement of information in the NOD, each Program that comprises a part of the HEO Directorate (i.e., ISS, COTS/CRS, MPCV has its own section. Section 2 describes the HSF Integrated Network, Operations Management Structure, Section 3 discusses the ISS Program including VVs, Section 4 covers the MPCV, and Section 5 describes the Commercial Crew Program (CCP). Section 6 describes the Network Planning and Coordination

requirements. Section 7 describes how HSF requirements are managed, and Section 8 defines the various readiness reviews that support the HSF Program.

1.3.2 Human Exploration Operations Mission Directorate

NASA Headquarters (HEO) defines the mission objectives, programs, and projects. The HSF Integrated Network provides communications and mission data services for the operations illustrated in Figure 1-1.

The HEO Mission Directorate provides the Agency with leadership and management of NASA space operations related to human exploration in and beyond low-Earth orbit. HEO also oversees low-level requirements development, policy, and programmatic oversight. The directorate is similarly responsible for Agency leadership and management of NASA space operations related to Launch Services, Space Transportation, and Space Communications in support of both human and robotic exploration programs.

The ISS, currently orbiting the Earth with a crew of six, represents the NASA exploration activities in Low Earth Orbit (LEO). These activities include Cargo Resupply Services (CRS) based on Commercial Orbital Transportation Services (COTS) development demonstration. Space Exploration Technologies (SpaceX) – Falcon 9 Launch Vehicle / Dragon spacecraft and Orbital Sciences Corporation (Orbital) – Antares Launch Vehicle / Cygnus spacecraft are the COTS and CRS providers.

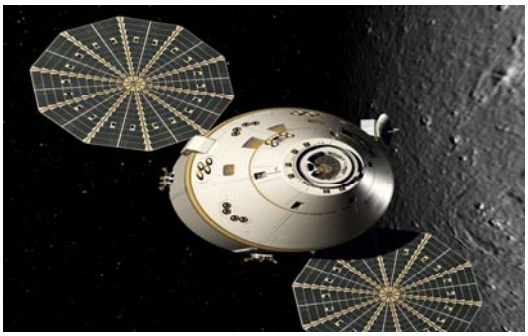
Exploration activities beyond LEO include the management of Commercial Space Transportation, Exploration Systems Development, Human Space Flight Capabilities, Advanced Exploration Systems, and Space Life Sciences Research and Applications.

The MPCV Program will provide the exploration vehicle that will carry the crew to space, provide emergency abort capability, sustain the crews during the space travel, and provide safe re-entry from deep space return velocities. The MPCV Orion spacecraft is to serve as the primary crew vehicle for missions beyond LEO, capable of conducting regular in-space operations (rendezvous, docking, and extravehicular activity) in conjunction with payloads delivered by the SLS for missions beyond LEO.

The SLS Program will develop a heavy-lift launch vehicle to expand human presence to celestial destinations beyond low Earth orbit. This launch vehicle will be capable of lifting the Orion MPCV to asteroids, the moon, Lagrange points, and ultimately for missions to Mars. It will also serve as a backup launch system for supplying and supporting the ISS cargo and crew requirements not met by other available launch vehicles.

The Commercial Space Crew Transportation Program will develop, in partnership with the commercial space industry, the capability to transport crews to and from the ISS. Examples are the Sierra Nevada Corporation (SNC) – Dream Chaser lifting body design, launched on the Atlas V vehicle and will be fully reusable to transport humans to the ISS and then return them to Earth using a runway landing. Boeing – Commercial Crew Vehicle (CTS-100) is a capsule-based commercial crew transport system for travel to and from the ISS using an Atlas V launch vehicle. Space Exploration Technology (SpaceX) will use a modified Dragon capsule and Falcon 9 launch vehicle for ISS crew transportation.

International Space Station (ISS)



Multi-Purpose Crew Vehicle

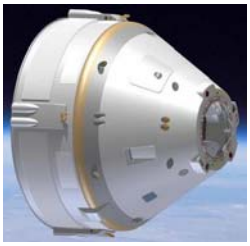
Space Launch System

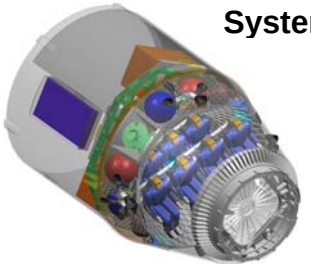
JAXA HII Transfer Vehicle

ESA - Automated Transfer

Orbital Science Cygnus

SpaceX Dragon





Commercial Crew – Mission Communications

Figure 1-1. Human Exploration Operations Programs and Projects

1.4 Human Space Flight Network Management

The Organizations that makeup the HSF Integrated Network are shown in Figure 1-2. These include JSC, GSFC, the Kennedy Space Center (KSC), the Glenn Research Center (GRC), the Marshall Space Flight Center (MSFC), the Langley Research Center (LRC), IT Infrastructure Integration Program (I3P) Communications Service Office (CSO), Mission Data Service Manager, and Dryden Flight Research Center (DFRC). The Department of Defense (DoD) HSF Network support is provided through the Eastern Range (ER), Western Range (WR), and the Air Force Satellite Control Network (AFSCN).

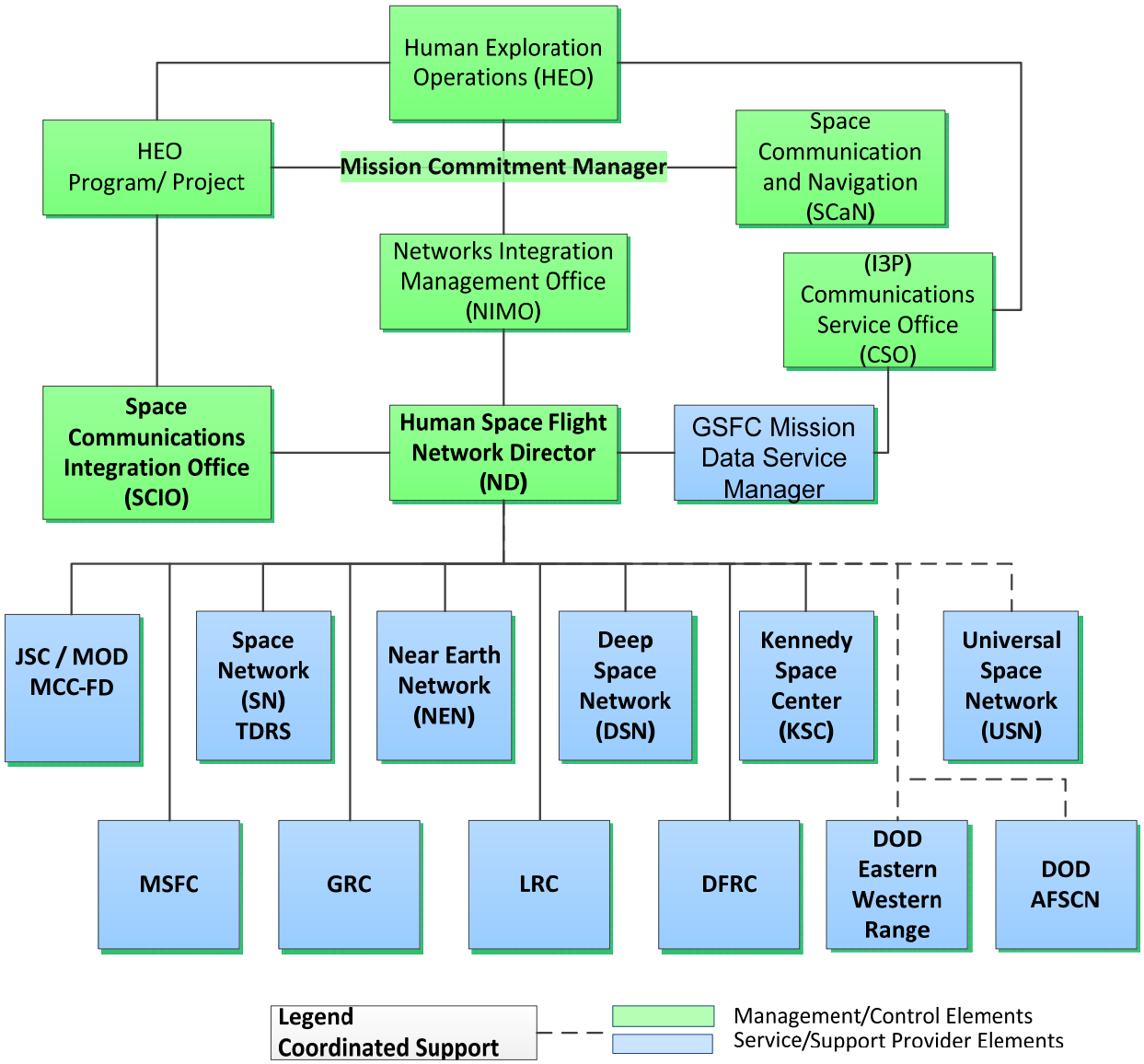


Figure 1-2. NASA Centers / DoD Elements Providing Mission and Data Services to HEO

1.4.1 Human Exploration Operations Mission Directorate

The HEO Mission Directorate established the Space Communication and Navigation (ScAN) to serve as the Program Office for all of the Agency's space communications activities. SCaN manages and directs the ground-based facilities and user services provided by the Near Earth Network (Ground Network) and Deep Space Network as well as the Space Based Networks.

1.4.2 NASA Mission Commitment Manager

The NASA Mission Commitment Manager (MCM) is located at NASA Headquarters in the Space SCaN program office. The MCM is responsible for funding and programmatic direction to the GSFC Network Integration Management Office (NIMO) and the Jet Propulsion Laboratory (JPL) Deep Space Network (DSN)/Mission Services Planning and Support Program activities. SCaN authorizes and commits Network assets (SN, Near Earth Network [NEN], and DSN) to provide mission support consistent with Programmatic Service Level Agreements (PSLA) with projects, programs, other agencies, and international space agencies.

1.4.3 Network Integration Management Office

The NIMO, located at the GSFC, establishes the general agreement with the network support elements such as JPL and DoD, to provide support to HSF Network Activities. NIMO assigns the ND with the responsibility and authority to implement and direct the network operations support of all HSF missions.

1.4.4 Space Communications Integration Office

The SCIO, located at JSC, works with the HSF Programs, Projects and Mission Operations to define and implement the network support requirements. SCIO works with the ND to implement the HSF network support as necessary to satisfy the program requirements. SCIO promotes the identification, analysis, documentation, and implementation of requirements and service delivery through interaction with the service requestor and service providers.

1.4.5 IT Infrastructure Integration Program Communications Service Office

NASA established the I3P CSO to provide agency-wide management, integration, and delivery of IT infrastructure services. CSO provisioned five major IT service acquisition contracts of which the NASA Integrated Communications and Services (NICS) is one. The NICS consists of program management, provisioning, and support of enterprise-wide, center and facility specific telecommunications, networking, security services, and collaboration services. Together these elements comprise the NASA Integrated Services Network (NISN). The CSO Mission Service Manager, Customer Interface Group, Network Services Group, and Russian Services Group interact with the ND, Space Communications Integration Office, and the HSF Integrated Network Elements to provide the communications services for HSF missions.

1.5 Related Documents and Web Sites

1.5.1 Documents

a. 450-AGMT-0004, *Memorandum of Understanding Between The Goddard Space Flight Center (GSFC) and the John F. Kennedy Space Center (KSC) NASA for GSFC/KSC Interfaces with the Eastern Space and Missile Center (ESMC).*

b. 450-OIP-WSC/DSMC, *White Sands Complex (WSC)/Data Service Management Center (DSMC) Operations Interface Procedures (OIP).*

c. 450-NOSP-Mission Specific, *Network Operations Support Plan*.

d. 450-SNUG, *Space Network Users Guide (SNUG).*

e. 450-HDBK-SN, *Space Network Handbook*.

f. 450-TNOSP-Mission Specific, *Tracking and Data Relay Satellite System Network Operations Support Plan (TNOSP) Plan*.

g. 450-CMFP-HSF/ELV, *Configuration Management Freeze Policy for the Integrated Networks and Supporting Elements*.

h. SSP 54001, *Space Station Program Support Requirements System Network Program Requirements Document (NPRD).*

i. SSP 54001, *Space Station Program Support Requirements System Network Program Requirements Document (NPRD), Annex 1 for SpaceX Dragon Visiting Vehicle*.

j. SSP 54001, *Space Station Program Support Requirements System Network Program Requirements Document (NPRD), Annex 2 for Orbital Cygnus Visiting Vehicle*.

k. MPCV/EFT-1, *Mission Support Requirements Document (MSRD).*

l. 450-TNOSP-ISS, *Tracking and Data Relay Satellite System Network Operations Support Plan for the International Space Station (ISS).*

m. 450-TNOSP-ISS VHF Annex, *Tracking and Data Relay Satellite System Network Operations Support Plan for the International Space Station Very High Frequency Annex*.

n. 450-TNOSP-ISS ATV Annex, *Tracking and Data Relay Satellite System Network Operations Support Plan for the International Space Station Automated Transfer Vehicle (ATV) Annex*.

o. 450-TNOSP-ISS HTV Annex, *Tracking and Data Relay Satellite System Network Operations Support Plan for the International Space Station H-II Transfer Vehicle (HTV) Annex*.

p. 450-TNOSP-ISS Dragon Annex, *Tracking and Data Relay Satellite System Network Operations Support Plan for the International Space Station (ISS) Dragon Annex*.

q. 450-TNOSP-ISS Cygnus Annex (still in process), *Tracking and Data Relay Satellite System Network Operations Support Plan for the International Space Station (ISS) Cygnus Annex*.

r. JSC 11534, *External Interface Control Document*.

s. JSC 27379, *Support Requirements System Management Plan*.

t. 450-CAP-GSFC-HSF, *Goddard Space Flight Center Human Space Flight Program Contingency Action Plan*.

u. 452-UG-SNAS, *Space Network (SN) Access System (SNAS) MOC Client Software User's Guide*.

v. SSP-54001, *Network Program Requirements Document for the ISSP*.

w. NISN-SOP-0002, N*ASA Integrated Services Network (NISN) Standard Operating Procedure for Trouble Reporting, Activities Scheduling, Mission Freeze, and Major Outage Notifications*.

x. 450-AGMT-007, *Memorandum of Agreement between the National Aeronautics and Space Administration Goddard Space Flight Center and Dryden Flight Research Center Concerning Communications, Tracking, and Data Acquisition Support to the Human Space Flight Program*.

y. Letter of Agreement between NASA Integrated Services Network Project and Goddard Space Flight Center's Customer Commitment Office concerning coordination and development of customer communication services requirements.

z. NISN-001-001, National Aeronautics and Space Administration (NASA) Integrated Services Network (NISN) Services Document,

aa. 450-AGMT-007, *Memorandum of Agreement between the National Aeronautics and Space Administration Goddard Space Flight Center and Dryden Flight Research Center Concerning Communications, Tracking, and Data Acquisition Support to the Human Space Flight Program*.

1.5.2 Web Sites

a.	FDF	http://fdf.gsfc.nasa.gov
b.	GSFC	http://www.nasa.gov/goddard
c.	HSF	http://scp.gsfc.nasa.gov/hsfnsg/hsd.html
d.	JSC	http://www.nasa.gov/johnson
e.	KSC	http://www.nasa.gov/centers/kennedy
f.	MSFC	http://www.nasa.gov/centers/marshall
g.	NEN	http://scp.gsfc.nasa.gov/gn
h.	CSO/NISN	http://www.nisn.nasa.gov/
i.	SN	http://scp.gsfc.nasa.gov/sn
j.	SNAS	https://cnts.gsfc.nasa.gov/snas
k.	WFF	http://www.nasa.gov/centers/wallops

l. DSN http://deepspace.jpl.nasa.gov/dsn/

m. DSN Commitment Office http://deepspace.jpl.nasa.gov/advmiss/#overview

1.6 HEO Mission Services Funding

HEO Directorate will provide funding to GSFC, as required, for GSFC managed mission services support to HEO Programs. This will require GSFC to support the Program Operating Plan (POP) processes, Basis of Estimate (BOE) information supporting the POP content, and monthly cost and performance metrics. GSFC will include JSC in their contractor evaluation input requests for those elements funded by JSC. JSC will provide to GSFC cost and performance assessments based on metrics information provided. This will be included in the GSFC contractor process.

1.7 Associate Contractor Agreements

JSC will task its HSF contractor (Facility Development and Operations Contract [FDOC]) with the generation of Associate Contractor Agreements (ACA) between JSC/FDOC and GSFC, Near Earth Networks Services (NENS), Mission Operations and Mission Services (MOMS), Space Communications Network Services (SCNS), and MSFC/Unified NASA Information Technology Services (UNITeS) for the purpose of establishing how business is conducted in a multi-contract environment and identifying management interfaces, processes, and Points of Contact (POC).

1.8 Configuration Management Process

The Integrated Network is required to implement a system-wide configuration management process in order to successfully integrate any equipment or changes into their system prior to and in conjunction with supporting HEO missions (ISS, VVs, MPCV, CCP). Because of the hazards inherent with HSF and continuous nature of the ISS (Mission), care must be taken to make certain there are no adverse impacts to mission operations. At the same time, changes to the Integrated Network System are required to sustain or enhance the Integrated Network Systems. All Integrated Network changes will follow a defined process to ensure there is sufficient time to plan, communicate, perform operations verification, and coordinate the change with the mission operation plan and schedules. The implementation of this process will ensure that there is appropriate notification of any impending change and that any required testing has been successfully completed to establish confidence in the change and validate its readiness to support the mission.

a. Each Integrated Network Element/Station must notify the GSFC ND and HSF Team of proposed configuration changes affecting HSF services.

b. The GSFC HSF Team will work with the Integrated Network Element/Station to evaluate potential impacts and determine End-to-End (ETE) testing requirements to ensure validation of the configuration change for mission support.

c. The GSFC HSF Team and Integrated Network Element/Station will work with the JSC Network and Communications Analysis and Integration Team (NACAIT), Ground Control Team to define the implementation, test, and operational transition sequences in context with mission operations plans and schedules.

d. The GSFC HSF Team will coordinate and conduct preliminary engineering tests as required followed by ETE network validation testing including all necessary Integrated Network elements. All test results will be documented with a Test Analysis Retrieval System (TARS) test report.

Section 2. Human Space Flight Integrated Network

2.1 Overview

The HSF Integrated Network is the primary focus of this document and plays an integral role in providing Tracking and Data Acquisition (T&DA) support to the HEO Programs and Projects. The Integrated Network represents a focused set of elements responsible as service providers to the HEO. The GSFC ND manages the HSF Integrated Network Operations. Coordination with the elements is through the Network Support Group (NSG) and other working groups defined to handle specific program operations or network element interfaces. The SCIO is responsible for the gathering, development, documentation, and operations integration of HSF operational support requirements, which consists mostly of Integrated Network Services. The NSG is comprised of management and technical authorities or representatives from each of the network organizations and elements. The integration of mission objectives, support requirements, network capabilities, test/verification activities, and mission operations execution through the Human Space Flight Mission Operations Directorate (HSF/MOD) is implemented through the elements shown in Figure 2-1.

2.2 JSC Space Communications Integration Office Structure

2.2.1 Interactions

The SCIO integrates the identification, analysis, documentation, and implementation of the support requirements defined through interaction with the various program and network elements. The interactions include Program Elements, Mission Operations Directorate (MOD) Flight Control Team (FCT), Mission Control Center (MCC), Systems Engineers, and Facility Interfaces, Test, Verification Plans, and Readiness Endorsement. SCIO works interactively with the ND to assess and integrate support capabilities with the support needs/requirements with the network elements. The Ground Control position implements the mission operations support needs in conjunction with the flight/mission operations plans to meet the mission objectives.

2.2.2 Primary Role

SCIO's primary role is to interact through the MOD and program elements in support of HEO Programs. These include space communications operations integration with other NASA Centers and DoD elements providing networks and communications support to the ISS, COTS/CRS, MPCV, CCP and SLS/MPCV mission and flight test operations. This office establishes and defines the working relationship between the MCC, tracking, and communications support providers. Figure 2-2 illustrates the SCIO Structure supporting HEO Missions. Figure 2-3 illustrates the SCIO interactions to integrate the Program Requirement, Operations Support Plan, and Certification of Flight Readiness (CoFR) with the Integrated Network Elements.

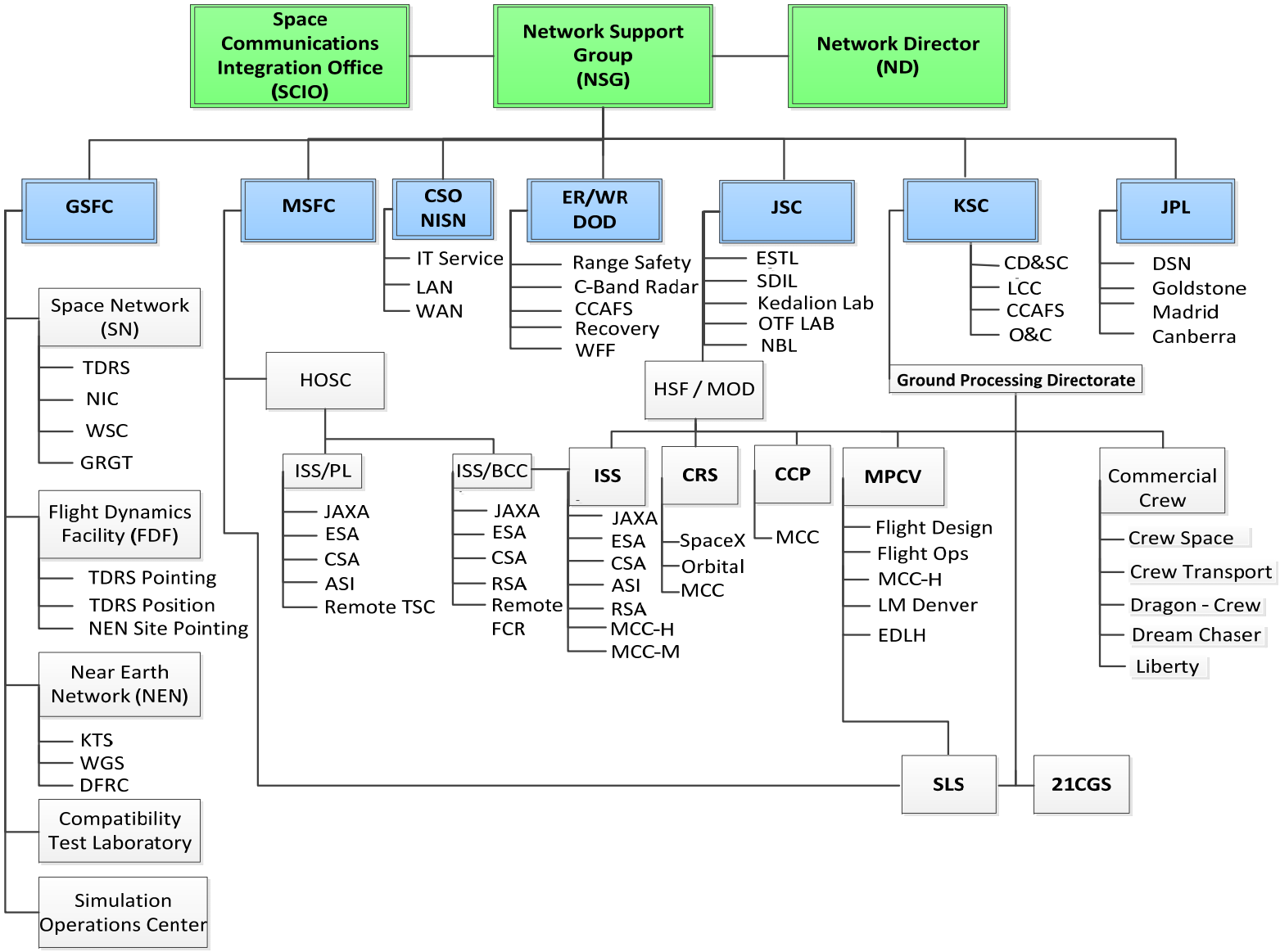


Figure 2-1. Human Space Flight Integrated Network Structure Supporting Human Exploration Operations

Pre-Decisional, For Internal NASA Use Only

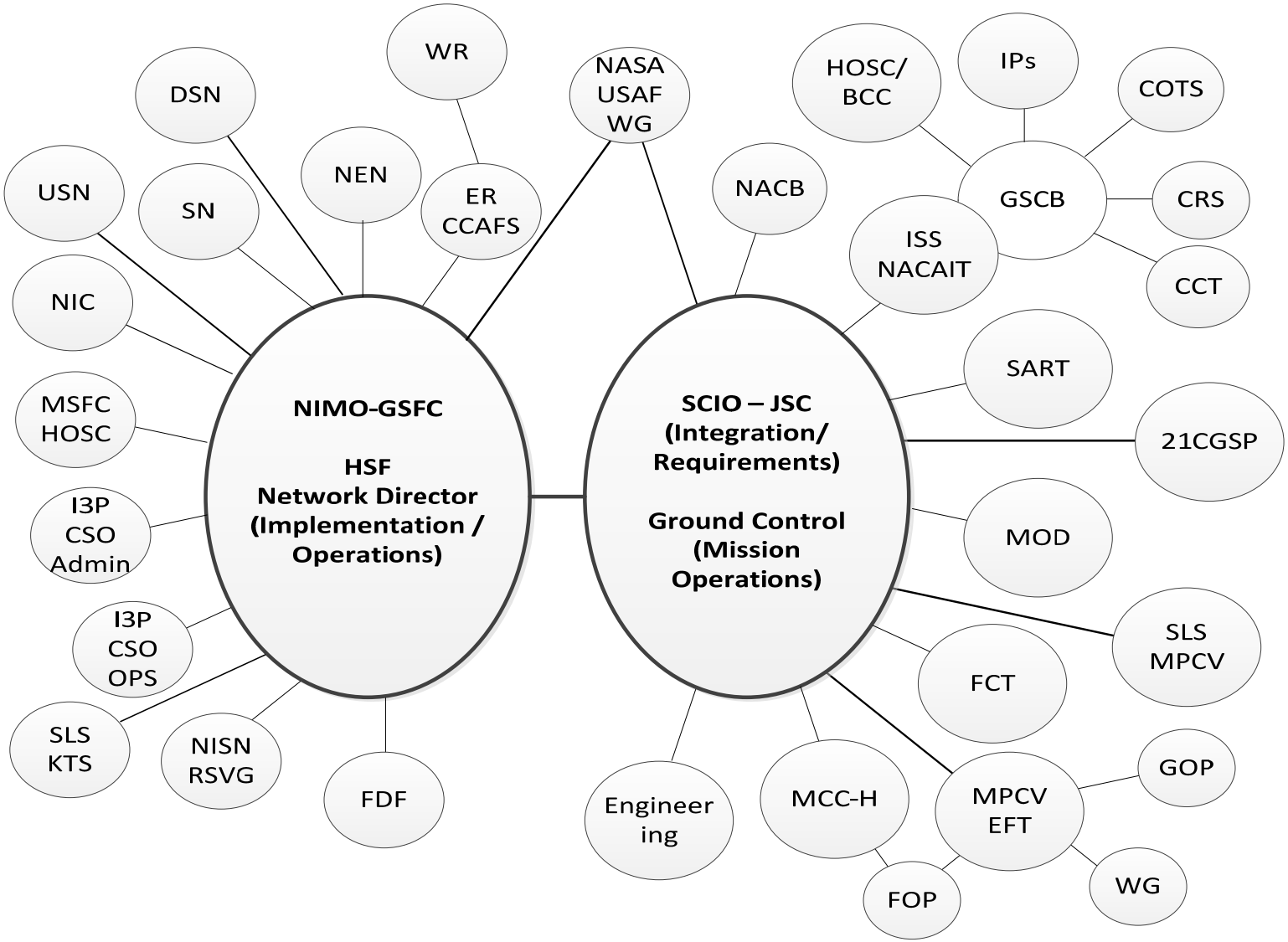


Figure 2-2. SCIO Structure Supporting HEO / HSF

Pre-Decisional, For Internal NASA Use Only

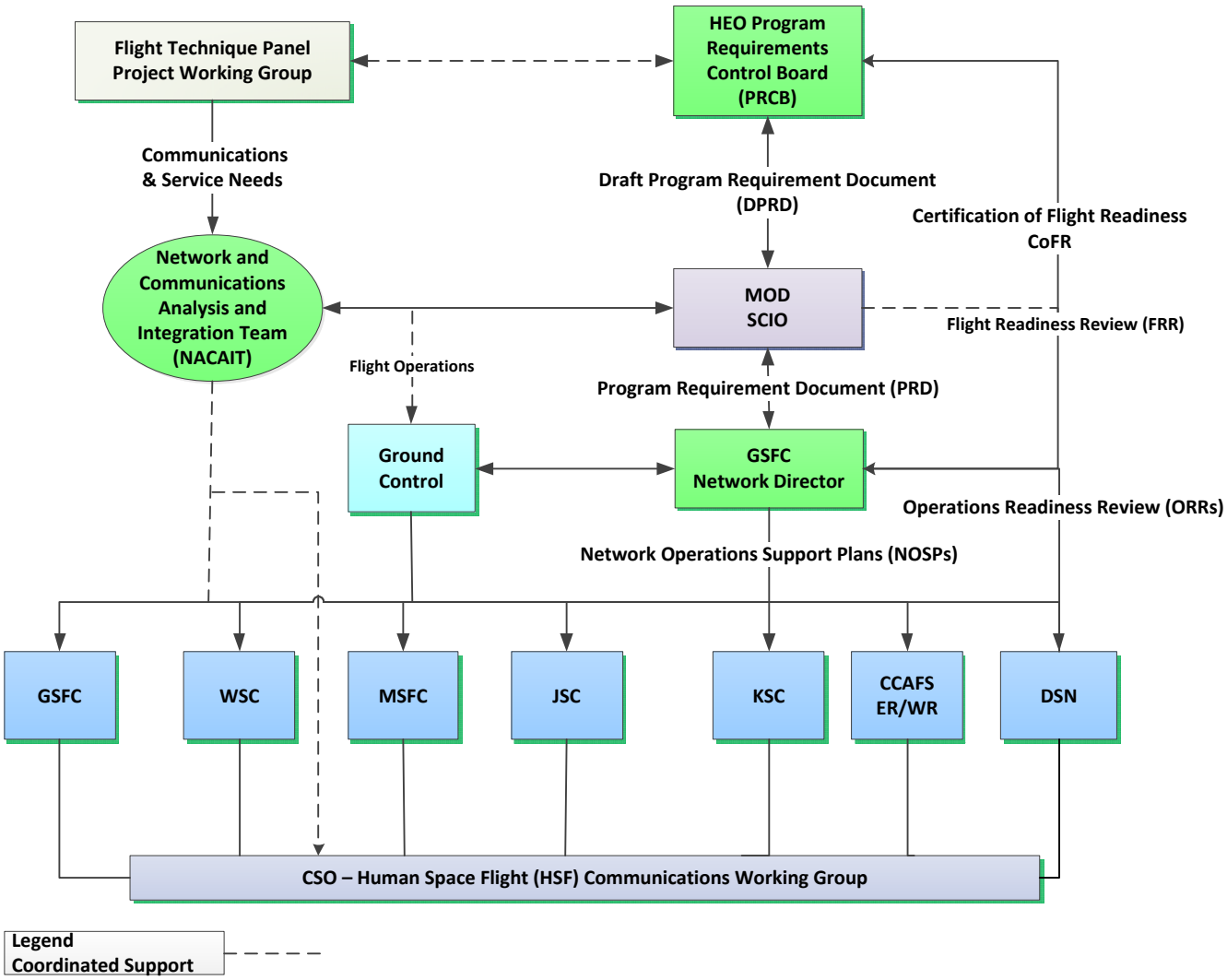


Figure 2-3. SCIO Integration of HEO / HSF Services

2.2.3 Reports/Information Exchange

The SCIO, in their relationship with the HSF Network Director at the GSFC, will provide the following reports:

a. Network Operations and Integration Team (NOIT) Summary Report.

b. Launch and Landing and other significant HEO mission event dates.

c. Mission/Flight Profile and Objectives

d. Readiness Review Dates and Topics and Certification Endorsement Criteria

2.3 Network Support Group

This section describes the NSG organization representative responsibilities and working groups that together implement HSF Network Operations. Several working groups support the NSG. These Include the NACAIT and the HSF Communications Working Group.

2.3.1 Network Director

The HSF ND chairs the NSG that is comprised of both management authority and technical experts for each of the HSF Integrated Network Elements as well as Program, Mission Operations and Flight Operations representatives. Several working groups support the NSG. The members usually meet face-to-face twice each year and interact as necessary to ensure the services are delivered to achieve the HEO mission objectives and crew safety. The following NSG members are the designated operations authorities for the Network Elements participating in the NSG:

a. NIMO.

b. ND.

c. SN.

d. Eastern and Western Range (DoD).

e. SCIO.

f. NOIT.

g. Ground Controller (GC).

h. .KSC - Communications Distribution and Switching Center (CD&SC).

i. Wallops Flight Facility (WFF) – Range Assets.

j. Wallops Ground Station (WGS) – Near Earth Network.

k. IT Infrastructure Integration Program (I3P) CSO.

l. MSFC Huntsville Operations Support Center.

m. CSO Mission Customer Services

n. CSO Mission Service Owner.

o. JPL DSN.

p. JPL - Flight Test Management Office (FTMO).

2.3.2 Operations Readiness Review

a. The purpose of the Operations Readiness Review (ORR) or Mission Operations Readiness Review (MORR) is to assess the readiness of the Integrated Network to satisfy the support requirements and to produce the CoFR based on the endorsement criteria for each requirement.

b. An overview of the mission, network support requirements and support plans, significant network changes, test and verification results, personnel training and certification and the status of significant anomalies are reviewed.

c. Each of the network elements present their operational changes, open discrepancy report status, open work, facilities overview, staffing, training, certification, and readiness assessment to the review board.

d. The review board is chaired by the GSFC, Code 301, Systems Review Office with board members representing the GSFC Senior Technical Authority, Chief of the Networks Integration Management, Navigation and Mission Design Branch, Communications and Security Services Division, Space Communications Integration Office, Ground Network Project, Space Network Project, and Human Space Flight ND.

e. The ND uses the results of these reviews to produce the Flight Readiness Review (FRR). The FRR package includes Requirements/Endorsements, Open Work and Exceptions, Significant Anomalies and Issues, and the Network Certificate of Flight Readiness.

f. The ND presents the FRR package to the JSC MOD with significant items included in the MOD package for subsequent Program or Project Flight Readiness Review.

2.3.3 HSF Communications Working Group

The CSO Customer Interface Group (CIG) chairs the HSF Communications Working Group. Participants include technical representatives from JSC, MSFC, KSC, GSFC as well as CSO System Managers (NSM), CSO Customer Support Representatives (CSR), Wide Area Network (WAN) Systems Engineering, JSC Systems Engineering, JSC Voice Control, KSC Voice Control, and the MSFC Ground Support Requirement Team (GSRT). The group reviews and manages the implementation of CSO projects in conjunction with the mission operations. Topics covered include Upcoming NISN Upgrade/Outages/Activities, NISN Project Status, NISN Service Request (NSR) status, and NISN Human Spaceflight Requirements. A summary of HSF working group activities are reported to, and coordinated with the NACAIT and NSG.

2.3.4 Network and Communications Analysis and Integration Team

The JSC SCIO chairs the Network and NACAIT. Participants include representatives from the European Space Agency (ESA), Canadian Space Agency (CSA), NISN Russian Services Group (RSvG), GSFC, MSFC, and Ground Segment Control Board (GSCB) as well as Systems Engineers for the Integrated Network elements. Topics covered include ESA, Italian Space Agency, Agenzia Spaziale Italiana (ASI), CSA and Roscosmos Gateway Service Status, VV Status, HSF Working Group Status, Integrated Networks Status/Program Projects Status, and Upcoming Events and launch schedules. Meetings agendas and participants vary based on the HSF Program topics, export control compliance, and sensitive-but-unclassified information and discussions.

2.4 Goddard Space Flight Center

2.4.1 General

The GSFC provides T&DA Network Management support for the HEO Missions. Figure 2-4 shows the GSFC management and operational structure for providing mission and data services to the HEO Missions. GSFC, in their relationship with JSC, will provide the following reports and/or documents to JSC for the integration of Human Space Flight Operations:

a. Network Forecasts.

b. Anomaly Reports.

c. Weekly Contractor Status Reports.

d. Significant Event Reports.

e. Integrated Network Daily Reports during missions.

f. Post Mission Anomaly Summaries.

g. Engineering Reviews.

h. ORR.

i. FRR.

2.4.2 HSF Network Director

The Exploration and Space Communications Projects Division (ESC) has assigned a ND to be responsible for the overall commitment of T&DA services and resources to support the HEO. These activities include advanced mission planning, network interfaces, requirements management, and documentation development. Through ESC Working Groups, the ND establishes operational guidelines, documents support requirements, and obtains support commitments. The ND is the coordinator of GSFC T&DA activities and maintains a close working relationship with mission Program elements at GSFC and JSC MOD SCIO to address issues on a continuing basis. The ND also interfaces with each element of the Integrated Network including the Network Integration Center (NIC), SN, NEN, ER/WR, WFF, DFRC, and other elements providing network support to the HEO (i.e., Flight Dynamics Facility [FDF], NISN, Simulation Operations Center [SOC], and the Compatibility Test Laboratory [CTL]). The ND chairs the ORRs at GSFC and chairs the NSG and participates in splinter and other working groups which are held on a regular basis to review previous missions, to discuss support plans for upcoming missions, and to notify customers of upcoming Integrated Network changes. The ND also presents the Integrated Network status at the JSC MOD FRR and the Program and HEO readiness reviews as part of the CoFR.

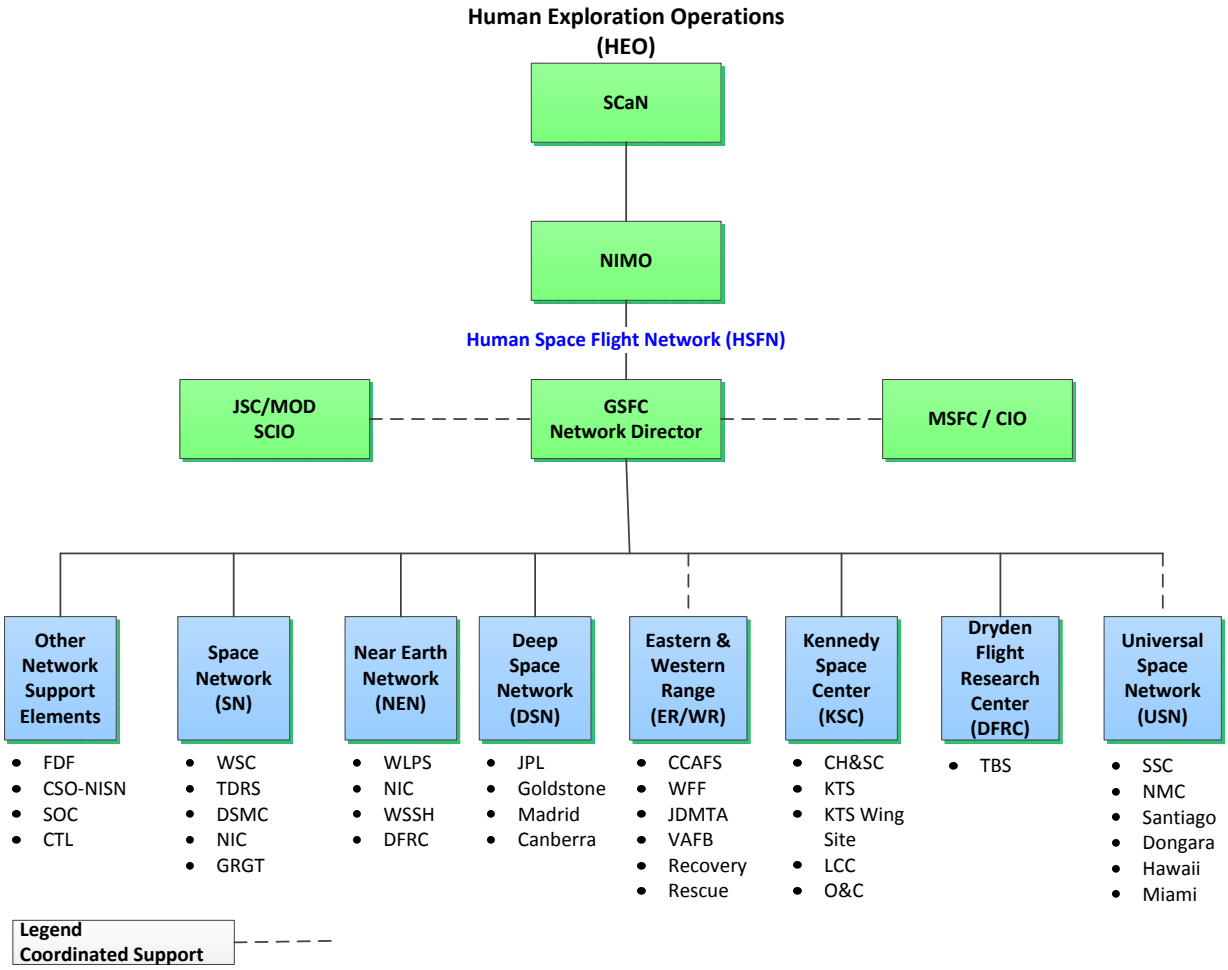


Figure 2-4. GSFC Structure for Providing Mission and Data Services to the HEO

2.4.3 Network Integration Center

The NIC (located at GSFC) houses NEN, SN and DSN remote network operations workstations. Spaceflight Mission Managers (SMM) use these workstations to manage the HSF Network elements. NIC operations management includes SN, DSN and NEN scheduling, configuration control, issue and fault resolution recovery and reporting during HEO testing, simulations, and flight operations. The NIC monitors critical mission operations and provides direction to the Integrated Network elements as required to sustain the mission services and achieve the mission objectives.

The NIC produces and implements the SN, NEN, and DSN NOSP, and Network Interface Test and Verification Plan activities. The NIC produces the test result, Network Director Reports, and conducts teleconferences with the Network elements supporting the HEO mission operations. The SMM presents the overall network status during readiness reviews and conducts the post mission reviews.

2.4.4 Space Network

2.4.4.1 General

The SN is the prime support element for overall LEO T&DA activities. The SN consists of Tracking and Data Relay Satellites (TDRS) in geo-synchronized orbits and ground terminals used to control the satellites and provide user forward and return link interfaces. The SN has two ground station terminals located at the White Sands Complex (WSC) in New Mexico as well as interfaces between WSC and the Guam Remote Ground Terminal (GRGT). SN user interfaces are via the WSC. HEO operations will require T&DA support during the development test and verification, pre-mission, launch, LEO, landing, and post-landing phases of each mission. The SN also includes the management of the TDRS assets, defining user and event priorities and the configuration management of all SN assets. The specific usage of the SN assets, configurations, interfaces, and services provided are defined through the JSC SCIO and ND with the HEO project specific mission objectives, configurations, flight plan and support requirements.

2.4.4.2 White Sands Complex

The WSC consists of the White Sands Ground Terminal (WSGT), Second TDRS Ground Terminal (STGT) and Guam Data Interface System (GDIS) with the GRGT. The WSC provides the interface and configuration control of the TDRS systems that provide forward and return link HEO spacecraft communications. The complex processes, monitors, and routes user spacecraft forward link data through the Space-to-Ground Link Terminal (SGLT) to the designated space-to-ground link terminals and Common Carrier Interface (CCI). Specific HEO spacecraft – SN services are remotely scheduled and controlled from JSC-MCC based on the test, or flight plan support requirements and in accordance with the Space Network Users Guide (SNUG). The mission specific configurations and procedures are defined in the TDRS Network Operations Support Plans (TNOSP) for that mission and mission vehicles.

2.4.4.3 Data Services Management Center

The Data Services Management Center (DSMC), located at WSC, provides the management function that schedules both the NEN and SN, and controls and monitors the SN. The WSC provides a real-time support interface between the SN, and Integrated Network support elements. This capability includes control of available network resources, schedule processing and conflict resolution, network testing, data monitoring, data base maintenance, and management reporting on network performance.

2.4.4.4 Tracking and Data Relay Satellites

The space segment of the SN consists of a system of geostationary TDRS that function interactively with the ground segments to provide K-band Single Access (KSA), S-band Single Access (SSA), and S-band tracking telecommunications services between the vehicle and ground-based control and data processing facilities. Figure 2-5 depicts the TDRS constellation array and space-to-ground link terminals. The specific configurations and TDRS supporting HEO missions vary based on the mission specifics and changes to the constellation management.

2.4.4.5 Space Network Ground Segment Sustainment

The Space Network Ground Segment Sustainment (SGSS) Project is to develop and implement an architecture using state of the art technology that is extensible, flexible, scalable and satisfies all service agreements. The SGSS goal is to meet or exceed the existing / legacy Space Network Ground Segment (SNGS) proficiency, performance and availability requirements. SGSS will provide Consultative Committee for Space Data Systems (CCSDS), Advanced Orbiting System (AOS) / Encapsulation and Space Link Extension (SLE) Services through the SN. The SGSS Preliminary Design Review (PDR) is planned for January 2012 with Critical Design Review (CDR) in April 2013 for ground terminal implementations and transitions from January 2014 through the Final Acceptance Review (FAR) in July 2015.

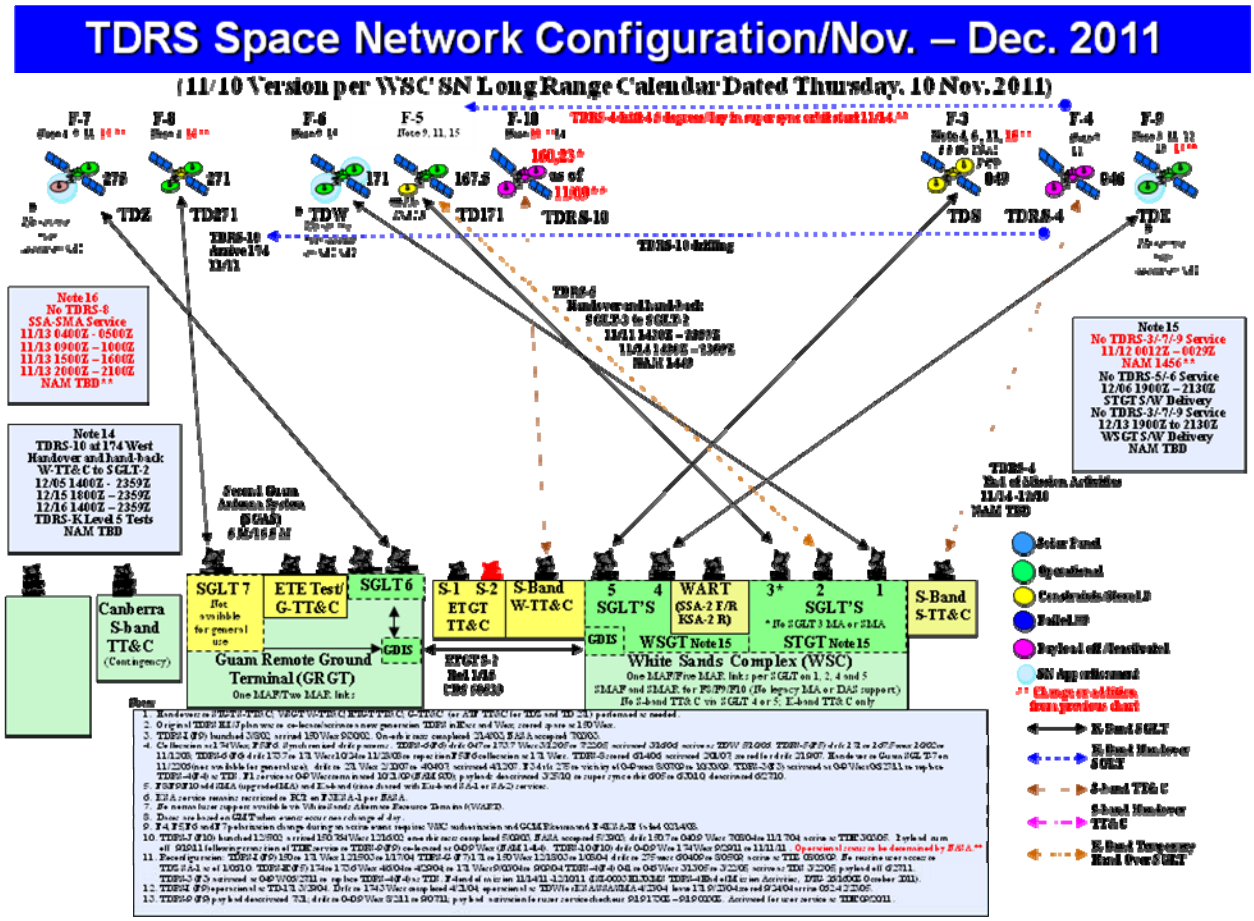


Figure 2-5. Example of the TDRS Constellation Supporting HSF

2.4.5 Near Earth Network HSF Operations

The NEN consists of existing and planned United States (U. S.) Government ground station assets as well as Universal Space Network (USN) commercially available ground stations assets

that may support the HEO/HSF pre-launch tests, launch, special orbital tests, landing and recovery, contingency and emergency support. The specific usage of the SN assets, configurations, interfaces, and services are defined through the JSC SCIO and ND with the HEO project specific mission objectives. The NIC implements the operations interactions between the network elements in conjunction with the flight plan and project specific NOSP.

a. U. S. Government Ground Station Assets are:

    1. Wallops Ground Station (WGS).
    2. DFRC Ground Station.
    3. SLS - Kennedy Tracking Station (KTS).
    4. AFSCN Ground Stations.
    5. Hawaii Tracking Station (HTS).
    6. Vandenberg Tracking Station (VTS).
    7. Diego Garcia Station (DGS).
    8. Guam Tracking Station (GTS).
    9. Colorado Tracking Station (CTS).
    10. New Hampshire Station (NHS).

b. USN Ground Stations are:

    1. Network Management Center (NMC) – Horsham Pennsylvania.
    2. Miami – Florida.
    3. Santiago – Chile.
    4. South Point Satellite Station, (Pete Conrad Station) – South Point Hawaii.
    5. Dongara – Western Australia.

2.4.6 Deep Space Network

The DSN is an international network of large antennas and communication facilities that supports spacecraft missions beyond LEO - interplanetary spaceflight. Deep space missions are visible for long periods of time from a large portion of the Earth's surface, so three main complexes are available along with the Deep Space Network Operations Center (DSN-OC) at the JPL in Pasadena California.

DSN Ground Stations are:

a. Goldstone Deep Space Communications Complex, Barstow, California.

b. Madrid Deep Space Communication Complex, Madrid, Spain.

c. Canberra Deep Space Communications Complex (CDSCC), Tidbinbilla, Australia.

2.4.7 Flight Dynamics Facility

The FDF located at the GSFC is responsible for creating and distributing tracking and acquisition (pointing data). FDF provides TDRS positional data to the mission control center for NEN and DSN ground spacecraft antenna pointing. The MCC provides spacecraft positional vectors and flight planned positional vectors for SN and Ground Station pointing and acquisition. FDF also produces tracking data products as defined through the JSC SCIO and ND with the HEO project specific mission objectives, configurations, flight plan and support requirements.

2.4.8 Simulation Operations Center

The SOC, which is located at GSFC, builds spacecraft simulators, data formatters, and other equipment needed to test NASA NEN telemetry subsystems, SN telemetry subsystems, and MOC interfaces. Test services are provided in the form of spacecraft simulations and compatibility tests, and are provided by resident simulator systems built on Motorola and Intel based computers. This provides ETE (spacecraft to experimenter or end user) simulations and tests needed to verify the readiness of the Project and/or the voice and telemetry networks needed to support the mission. These systems also provide the flight operations personnel a platform to test procedures for validity and conduct Launch and orbital proficiency training. In addition, the SOC will act as a substitute for the JSC MCC if the Electronic Systems Test Laboratory (ESTL) at JSC is not available. JSC SCIO and ND along with the HEO projects define the mission specific objectives, configurations, flight readiness and other SOC support requirements.

2.4.9 Compatibility Test Laboratory

The CTL, located in Building 25 at GSFC, provides test systems to reflect the current capabilities of the SN. The CTL has an Radio Frequency (RF) shield room and can support SN testing of user transmitters, transceivers, and transponders, including a relay link to TDRSS. A transportable van that works with the CTL can be used at the spacecraft manufacturer's plant, and the Launch site or other location to ensure that Integrated Network operational parameters are compatible with actual mission requirements, and new spacecraft parameters are within those requirements prior to launch. In addition, CTL engineers support testing in foreign countries by providing an equipment rack configuration of compatibility testing equipment which can be shipped to those facilities. The results of the CTL specify, verify and validate the detailed technical configuration used by the T&DA assets to acquire vehicle signal and data during flight. The JSC SCIO and ND utilize the CTL to produce compatibility test plans from the manufacturers Radio Frequency Interface Control Document (RFICD) which provides a means of testing the specific vehicle under conditions which simulate the actual network configurations and provide reliable results prior to the actual mission.

2.5 Johnson Space Center

2.5.1 Network Operations Integration Task

The NOIT provides technical integration support that includes systems analysis and engineering assessments to the SCIO. The NOIT identifies or refines program support requirements or

changes, through work with the various communities to validate the requirements, and resolve discrepancies, issues or action responses. The NOIT works with the NSG and NACAIT in planning the integrated implementation of space communications data services required to support HEO missions and evaluates CoFR endorsement codes and network implementation. NOIT also provides and independent voice for identifying problem areas, workaround and resolution options.

2.5.2 Mission Control Center

The MCC is a MOD managed facility that serves as the focal command and control point for HSF flight mission operations. The facility consists of Flight Control and Flight Support Rooms, and Systems Architecture that includes Communications Subsystem, Facility Management Subsystem, External Data Services, Data Storage Subsystem, Space Flight Meteorological Subsystem, Common Services and Local Area Networks (LAN).

MCC Operations controls the systems and interfaces during scheduled tests, flight tests and throughout the flight operation phases. Based on the flight support requirements and mission objectives the MCC defines the specific external element and network elements interface configurations, support criticality, and support times. These items are defined during the flight plan developed through the Flight Technique Panel, Joint Operations Panel (JOP) and Flight Test Working Groups chaired by the Flight Director (FD) Office. These plans are verified through mission simulations, tests, and checkout activities.

2.5.2.1 Houston Ground Control

The Ground Control position is the MCC Flight Control Room (FCR) position responsible to the Flight Director for the operations of the MCC, and Integrated Network interfaces to provide spacecraft – ground communications and ground-to-ground services as necessary to sustain crew safety, accomplish the mission objectives and meet the program requirements. The GC is responsible for providing telemetry, command, trajectory data, voice, video, and communication services and is the authority for the overall control of the real-time Integrated Network and MCC operations.

2.5.3 Electronics Systems Test Laboratory

The ESTL is an engineering directorate managed facility with the capability to emulate the spacecraft forward and return link data services and to transmit and receive the communications links thorough the SN, TDRS, WSC and MCC interfaces. This capability is used to perform end-to-end Operations Readiness Tests (ORT) or engineering verification checkout activities. The specific usage of ESTL is defined through the HEO project specific test and checkout configurations and requirements.

2.5.4 JSC- Software Development Integration Laboratory

The Software Development Integration Laboratory (SDIL) is an ISS Program Avionics and Integration Office managed facility with the capability to emulate the ISS hardware and software for development, integration, and verification test activities. Interfaces with the ESTL and MCC provide the capability to conduct checkout of individual components as well as performing end-

to-end tests to verify the systems readiness before the element is installed or activated on-board the ISS.

2.5.5 Exploration Development Laboratory Houston

The Exploration Development Laboratory Houston (EDLH) is a Lockheed Martin (LM) managed facility with the capability to emulate the Orion Spacecraft Avionics software for development, integration, and verification purposes. EDLH has two major areas (1) Software Only Crew Escape Vehicle (CEV) Risk Reduction Analysis and Test Engineering Simulation (SOCRRATES) and (2) Houston Orion Test Hardware (HOTH). Interfaces between EDLH and MCC support the development and verification of mission control center displays and data processors for Orion command, telemetry and file transfer capabilities.

2.6 Communications Service Office

In accordance with established organizational structures, the NASA CSO is under the direct governance and management control of the NASA Office of the Chief Information Officer (OCIO). NASA CIO has delegated responsibility for Communications Services and full authority for the CSO to the NASA OCIO Enterprise Services and Integration (ES&I) Division.

ES&I has assigned responsibility for the CSO and its functions of IT service management and service delivery of Communications Services to the Enterprise Service Executive (ESE), host center CIOs (MSFC, GSFC, Ames Research Center [ARC]) and the CSO Service Office Manager (SOM).

a. MSFC will provide leadership for the overall program management, administrative and financial management, and management of the Corporate WAN, Center LANs, and Center services. All MSFC CSO staff report functionally to the MSFC CIO.

b. GSFC will provide leadership for the overall management of the mission networks. All GSFC CSO staff also report functionally to the MSFC CIO.

c. ARC will provide integration and leadership in the areas of IT security, research networking, emerging network technology and innovation, enterprise architecture, and project management governance. All ARC CSO staff report functionally to the MSFC CIO.

d. GSFC Mission Services Responsibilities include leadership for the overall management of the mission networks. The Data Service Manager at the GSFC provides the Mission Services support voice, data, and video between Mission Project Control Centers, Launch Complexes, the Ground Stations of the SN, NEN and DSN for Mission Customers.

Figure 2-6 shows the CSO structure for supporting HEO / HSF network operations activities by the Data Service Manager.

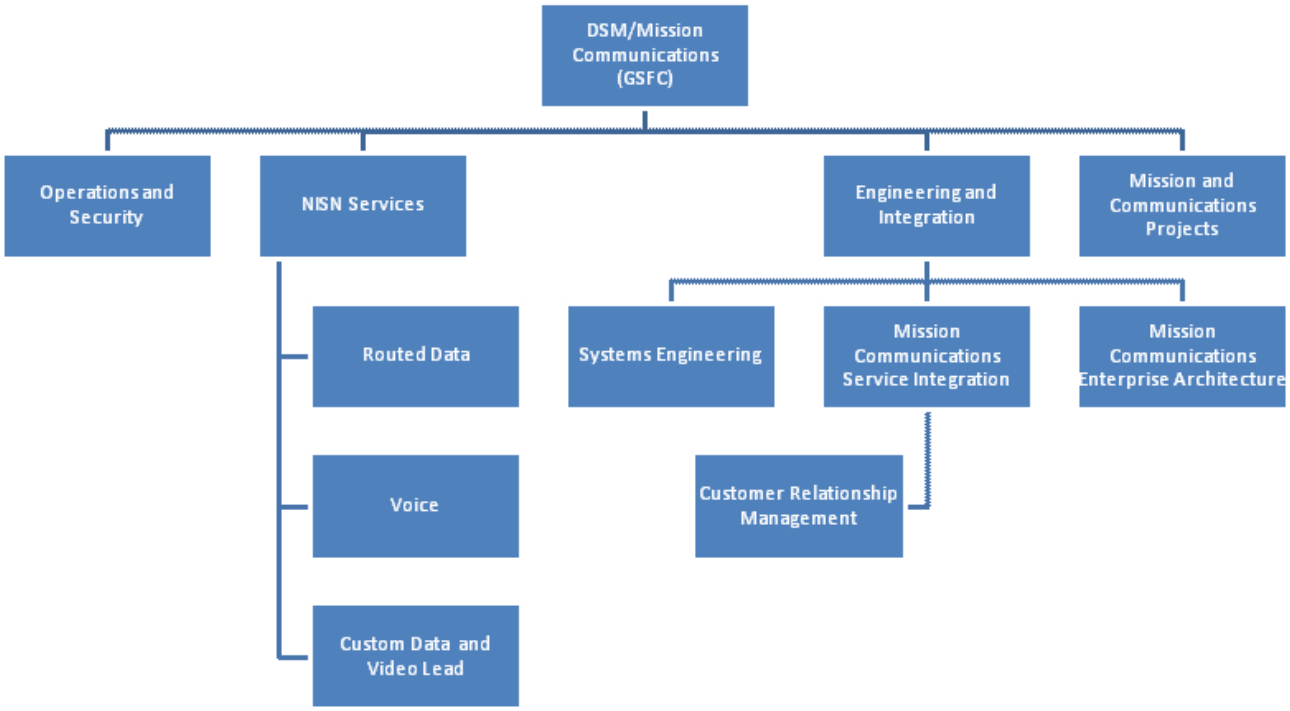


Figure 2-6. CSO Data Service Management Structure for Supporting HEO / HSF Network Operations Activities

2.6.1 CSO Mission Operations

NASA CSO provides a worldwide complex of communication services (formerly called the NISN that includes optical carrier data and data routing services, voice, video, and television services. CSO Mission Operations is responsible for ensuring the integrity of all services and support to include monitoring, problem identification, troubleshooting, trouble ticket management and dispatch, problem resolution and coordination between support entities.

2.6.1.1 Communications Manager

CSO Communications Managers (Comm Mgr) are responsible for managing the day-to-day operations of the NISN managed networks. They are the primary interface for reporting and obtaining status updates on all network related issues.

a. The primary responsibility of the Comm Mgr is to ensure reliable transport of high and low speed data, voice, and video between tracking stations, Project Operations Control Center (POCC), NIC, FDF, and experimenter facilities.

b. Their support includes: the prioritizing of troubleshooting activities; authorizing or deferring work during Mission Freeze Periods; preparing Mission Outage Notifications (MON) for distribution to the NASA community; and interfacing with all NASA Centers, tracking stations, domestic and foreign space agencies, and commercial

carriers. The Comm Mgr also works in concert with the Mission Communication Manager (MCM) during those periods when the MCM Console is staffed for launches and simulations.

2.6.1.2 Mission Communications Manager

a. The MCMs organize, coordinate and maintain the Mission support materials and documentation required for CSO's support of current and proposed HSF and Expendable Launch Vehicle (ELV) Missions to include the support of all network test and simulation activities.

b. MCMs interface with CSO CSR, Mission Operations and Engineering personnel, and customers to define Mission requirements and to coordinate circuit and system configurations and usage for each mission. They also participate in all HSF and ELV mission phases including readiness, pre-launch, and on-console support during launches, and post mission analysis and meetings.

2.6.1.3 Goddard Communication Control

The Goddard Communications Control is primarily responsible for the efficient operation and management of the NASA global voice and data communications network, consisting of diversely routed satellite and terrestrial circuitry supporting optical carriers, wideband communication channels, Internet Protocol (IP)-routed data services for the NISN Mission Network, high speed data, and low speed data (teletype) in support of NASA missions, projects and launches. The Goddard Communications Control proactively monitors network devices, troubleshoots WAN and other network problems, troubleshoots connectivity and data flow problems with end users, project support, network testing, and network engineering. The Goddard Communications Control section also has responsibility for the management of the Conversion Devices. These geographically dispersed, NASA-unique devices convert data to and from any of these formats: synchronous clock and data, Transmission Control Protocol/Internet Protocol (TCP/IP), and User Datagram Protocol/Internet Protocol (UDP/IP) (unicast and multicast) addressing for the support of data communications on the mission network.

2.6.1.4 GSFC Voice Technical Operations

The Voice Technical Operations (VTO) Section is the voice hub of NASA's Mission Critical Network. This facility establishes voice conferences to NASA networks and mission control centers and other interconnecting government agencies. The VTO Section also provides technical support through monitoring, testing, and resolution of voice communications issues.

2.6.1.5 NASCOM Network Scheduling Group

The NASA Communications (NASCOM) Network Scheduling Group (NNSG) supports the coordination of mission-related activities and service outages with the NASA customer community via Briefing Messages. They schedule satellite transponders, system and circuit releases, and the compilation and distribution of solar interference predictions. The NNSG also handles notifications forms and reports detailing impending mission freeze windows and Freeze

Exemption Requests (FER) for Organizations/Projects who have a requirement/need to conduct an activity during Mission Freeze Periods.

2.6.1.6 CSO Outage Scheduling

All activities (repairs, modifications, installations) which have the potential to interrupt or impact normal communications activities both non-mission and mission-related must be requested/scheduled through the NNSG to safeguard against unscheduled system outages. The NNSG reviews all requests for conflicts with other scheduled activities or critical events. The NNSG issues a "Release Calendar" to the network showing all scheduled activities and circuit releases in accordance with NISN-SOP-0002, *NISN Standard Operating Procedure for Trouble Reporting, Activity Scheduling, Mission Freeze, and Major Outage Notifications.*

2.6.2 HSF Communications Working Group

HSF Communications Working Group (CWG) is chartered by the CSO – Data Service Manager (DSM) and consists of the service owner and customer service representatives with participation by engineering and operations representatives from the HSF centers. The CWG generally meets via teleconference weekly with face-to-face meetings twice each year as a NSG splinter group meeting. The group's objectives are the identification and implementation of the NICS Service Requests (NSR), project implementation status, service requirements identification, and near-term work plans. The CWG works interactively with the NACAIT for requirement identification and implementation status.

2.6.3 Mission Communications Working Group

Mission Communications Working Group (MCWG) is chaired by the GSFC MCM and is a forum for mission communications operations and engineering personnel from the NASA, DoD, and other agencies supporting the HEO communications, integrate and coordinate their communications operations activities, (i.e., system and/or service utilization, service activation and acceptance testing, procedures development, service restoration and troubleshooting techniques, system analysis, and technical interchanges). MCWG generally meets annually to review significant projects or changes planned that affect the mission communications interfaces and systems.

2.7 Eastern Range / Western Range

The ER, located at Cape Canaveral Air Force Station (CCAFS), is a rocket range that supports missile and rocket launches at CCAFS, KSC. The range has also supported Ariane launches from the Guiana Space Centre as well as providing support for launches from the WFF. The range consists of a chain of shore and sea based tracking sites known as the Morrell Operations Center (MOC) Range Operations Control Center (ROCC). HSF – ER /WR support requirements are defined and implemented through the Program Requirement Document (PRD) process. The ER is also designated as the lead range for the requirement integration, scheduling, and operations of eastern and western range assets and services. All HEO / HSF range support requirements, services and operations interactions are controlled through the ER, Program Support Manager.

2.7.1 Cape Canaveral Air Force Station

The CCAFS is an installation of the United States Air Force Space Command's 45th Space Wing, headquartered at Patrick Air Force Base. Located at Cape Canaveral, Florida, CCAFS is the primary launch head of 'the ER and includes space launch complexes (SLC), Morrell Operations Center (MOC) ROCC, Cape Canaveral Forecast Facility (CCFF) Meteorological Interactive Data Display System (MIDDS), Hanger AE and XY Facilities.

2.7.1.1 Flight Operations Version One

Flight Operations Version One (FOV1) consists of two independent systems that are located in the Morrell Range Operations Control Center at CCAFS. The FOV1 systems provide the capability for Range Safety to monitor launch vehicle performance, process and distribute tracking data and vehicle positional vectors. The systems acquire and process instrumentation data from CCAFS and range sites through redundant network paths, processed and distributed via the Launch and Landing Tracking Data System (LLTDS). These systems generate flight path and predicted point displays.

2.7.1.2 Meteorological Interactive Data Display System

The United States Air Force (USAF)'s CCFF, MIDDS ingests special mesoscale meteorological data sources, merges them together into a gridded data base, integrates the data into forms where they can be displayed alone or in conjunction with correlative data, and then displays the required meteorological information quickly and easily. MIDDS interfaces with the MCC Spaceflight Meteorology Group to provide capabilities required for HSF launch and landing operations.

2.7.2 CCAFS – Hanger AE

Hanger AE houses the NASA Launch Vehicle Data Center (LVDC). Hangar AE control rooms provide real-time voice, data, and video information for expendable vehicle checkout and launch operations. Interfaces between Hanger AE and KSC CD&SC provide the capability for data, voice, video, and countdown timing with the HSF Network Elements.

2.7.3 CCAFS – XY

Building XY of CCAFS, is the Range Communications distribution hub, providing the voice, data, and video interfaces with the range assets at CCAFS as well as down range stations, ships, and aircraft via the DOD network. Interfaces between CCAFS XY and KSC CD&SC provide the primary interface for data, voice, video, and countdown timing services from the range elements, NASA CSO and HSF elements.

2.8 Kennedy Space Center

KSC includes the CD&SC, 21st Century Space Launch Complex, CCP Development, Operations Checkout Facility (O&C) and other facilities used to perform vehicle preparation and launch operations.

2.8.1 Communications Distribution and Switching Centers

CD&SC is the central facility and the hub of communications services within the KSC and interfaces with the HSF network. These interfaces provide voice, data, and video services for HSF missions.

2.8.2 21st Century Space Launch Complex

The 21st Century Space Launch Complex (21CSLC) is an initiative to modernize the KSC launch and range complex for current and future NASA programs along with other commercial users. The 21CSLC Program will develop and implement shared infrastructure for development, activation, operations, and maintenance capabilities to manufacture, assemble, test, checkout, and launch HSF vehicles. The initiative includes upgrades of the Launch Control Center (LCC) Firing Rooms in Launch Complex 39, as well as industrial area elements and the KTS for SLS and Commercial Crew Launch operations.

2.8.3 Commercial Crew Program

KSC is the lead center for the CCP with participation from other centers and elements. The goal is achieving safe, reliable, cost effective access to LEO in which commercial space transportation services are available to Government and private sector customers. The Commercial Crew Section of this document describes the assumptions and interactions for HSF network support of CCP.

2.8.4 Operations and Checkout Facility

Orion payload and vehicle launch components are to be received, assembled, integrated, and verified before they are moved to the SLC. Interfaces between the O&C facility and CD&SC provide the capability to perform command, telemetry and file transfer end-to-end checkouts with the MCC.

2.9 Marshall Space Flight Center

2.9.1 Huntsville Operations Support Center

The MSFC Huntsville Operations Support Center (HOSC) supports the HEO elements including the ISS Backup Control Center (BCC), Payload Operations Integration Center (POIC) and SLS Project. The MSFC ISS support elements are delineated in the ISS section of this document.

2.9.1.1 Space Launch Systems

MSFC will be responsible for the Main Propulsion Systems (MPS) of the Space Launch Systems. It is assumed that the HOSC will provide the engineering support function for the MPS and will require HSF network support to provide telemetry, voice and video for SLS development, flight test and mission operations. The HOSC receives voice (from KSC, JSC, and GSFC and all remote centers), video and data stream for real-time monitoring of their SLS elements, as well as the ground support elements.

2.10 Glenn Research Center

The GRC provides Spectrum Management support for the HEO vehicles. This primarily includes resolving Radio Frequency Interference (RFI) incidents that may occur during the pre-launch, Launch, orbital, and landing phases of missions. RFI is the undesired reception of electromagnetic emanations of sufficient signal strength and proximity to a mission-assigned frequency and timeline to cause degradation or complete loss of data and/or voice communications.

2.11 Langley Research Center (LRC) – TBS

2.12 Dryden Flight Research Center Ground Station

The DFRC provides Very-high Frequency (VHF) voice communications support to the ISS, and contingency support to the Soyuz spacecraft during critical early orbit launch support or orbital operations while attached to the ISS or operating in proximity to the ISS. DFRC provides VHF - 1 support for the Service Module (SM) and VHF-2 for the Soyuz, as scheduled, for the bi-directional transmission of mission critical data packets or voice. DFRC will support on Orbits 6, 7, and 8 per the early orbit timeline provided by ISI.

Section 3. International Space Station Program

3.1 Overview

3.1.1 General

a. International Space Station Program (ISSP) is a joint endeavor with the United States, Europe, Japan, Russia, and Canada. The station consists of on-orbit, ground segments components and visiting vehicles from the ESA, Japan Aerospace Exploration Agency (JAXA), CSA, ASI, the Russian Space Agency (RSA), and NASA.

b. The ISS has a width of approximately 361 feet, a length of 290 feet, and a mass weight of 1,005,021 pounds. It orbits Earth at an approximate altitude of 220 nautical miles. The orbital inclination of the ISS is 51.6 degrees, which makes about 85 percent of the Earth's surface observable. The station accommodates six people with three people assigned to an expedition crew. Each expedition is approximately six months in duration. Normally six crewmembers (two expeditions) are on on-station performing science, routine maintenance and other activities. Increments span a 3 or 6 month period of time that defines the specific activities or events to be performed during that increment.

c. The construction of the ISS began with the Launch of the first element, the Russian Zarya Control Module, on November 20, 1998. The United States On-orbit Segment (USOS) construction completed with the installation of the Permanent Multipurpose Module (PMM) during the Space Transportation System (STS)-133 flight on March 1, 2011.

d. Crew habitation began with the arrival of Expedition 1 crew on November 2, 2000. Crew rotation on approximately 6-month intervals has provided continuous habitation on the orbital outpost. Starting on May 29, 2009, six-crew member occupation began.

3.1.2 Mission Description

3.1.2.1

The mission of the ISS is to establish a permanent international presence of humans in space and to bring nations together for the benefit of life on Earth, learn how to live and work in space, make revolutionary discoveries, advance the exploration of our solar system, and enable commerce in space. The ISS is comprised of segments that are linked together to provide habitation, experimentation, communications, and transportation of supplies and humans to and from the Space Station. Connectivity between the segments provides seamless utilization of the station segments by all partners. Continuous habitation and operations are planned through 2020.

3.1.3 United States On-orbit Segment

The USOS provides the principal communications interface through the SN forward and return links for command, control, and science experiment operations. The Ground Segment provides the interfaces between the SN and ISS users via the Mission Control Center Houston (MCC-H) and interfaces with Mission Control Center Moscow (MCC-M), POIC at the MSFC, ESA – German Space Operations Center (GSOC), JAXA Space Station Integrated Promotion Center (SSIPC), ASI, and CSA. The Ground Segment provides the command and control telemetry, voice, and video through the JSC MCC-H and International Partner gateway. The POIC at the MSFC provides the interface with the SN for experiment data and the ground segment interfaces for the Telescience Support Centers and International Partner Science operations.

3.1.3.1 Network Operations

MCC-H is the prime site for planning and execution of integrated system operations of the ISS. Operations include the Space Segment, Ground Segment and BCC. The MCC-H is also the prime site for the scheduling, integration and delivery of network services. The POIC is the prime site for the planning and execution of payload / science activities and works in conjunction with MCC-H to schedule, configure, and control the SN and Ground Segment resources to meet the program milestones and objectives. The POIC also manages the interfaces with the telescience centers around the world to perform experiments and operate science instruments on the ISS.

3.1.3.2 USOS Communications Link Operations

Through the MCC-H and POIC gateway interfaces, the International Partners utilize the TDRS communications links with the USOS for monitoring and controlling the Station Module Systems, Payload Science/Experiment Operations, as well as Crew Conferences and other mission activities. The USOS-TDRS S-band and K-band links are the primary communications link for all Space Station and station proximity operations. Planned for delivery in 2012 / 2013 the Obsolescence Driven Avionics Re-Design (ODAR) project will increase the K-band links to 25 megabits forward and 300 megabits return to significantly increase the capacity to perform telescience.

3.1.3.3 USOS Contingency – Russian Segment Communications

Ground Segment interfaces between MCC-H and MCC-M along with on-board interfaces between the Russian Segment and USOS provide the capability for telemetry and command of the USOS through Russian ground stations or space communications assets from MCC-H. When significant issues prevent communications through the USOS links the path through Moscow can be activated.

Radio relay to and from the Russian segment along with the USOS interface, and Ground Segment interfaces are used by flight controllers in the MCC-M for Russian segment activities for general operations, spacewalks, Progress and Soyuz visiting vehicle operations.

3.1.4 Visiting Vehicles

3.1.4.1 General Description

Visiting vehicles transport crewmembers, cargo, and supplies to and from the ISS. These include the Russian Soyuz and Russian Progress Vehicles, ESA Automated Transfer Vehicle (ATV), JAXA H-II Transfer Vehicle (HTV), and CRS vehicles.

HSF Integrated Network Elements and Services provide support of the vehicles operations from launch through docking and undocking through re-entry. The specific services vary based on the specific vehicle support requirement and agreements as well as the flight phase of the VV. The flight phases are launch through proximity/attached operation and release through de-orbit, re-entry and landing.

The Commercial Crew and Cargo Program (C3PO) office at JSC established Space Act Agreements (SAA) with SpaceX and Orbital, to develop and perform COTS flights. SpaceX is developing the Falcon 9 launch vehicle and Dragon Spacecraft while Orbital is developing the Antares Launch Vehicle and Cygnus spacecraft. The COTS demonstration flights are planned to occur in 2012. Following the successful completion of the COTS demonstration, Falcon 9/Dragon and Antares/Cygnus will provide CRS to the ISS Program. The HSF interfaces and operations used for the demonstration flights will be applied for the CRS operations.

3.1.4.2 Visiting Vehicle – Direct Link Services

HSF Integrated Network Elements and Services provide direct support of the vehicles operations. Specific services vary based on the specific vehicle support requirement. TDRS direct link communications are provided through the WSC, MCC-H, and Ground Segment Gateway interfaces with the VV Control Center. Emergency VHF communications for Soyuz VVs is provided through the NASA ground Stations, GSFC, MCC-H and MCC-M. MCC-H ISS GC schedules and performs the Integrated Network VV direct link acquisitions operations to provide the services listed in Table 3-1.

HSF Integrated Network Elements and Services provide direct support of the vehicles operations Specific services vary based on the specific vehicle support requirement and capabilities. TDRS direct link communications are through the WSC, MCC-H, and Ground Segment Gateway interfaces with the VV Control Center. Emergency VHF communications for Soyuz VVs is provided through the NASA ground stations, Goddard, MCC-H and MCC-Moscow (MCC-M).

The MCC-H ISS GC schedules and performs direct link acquisitions operations to provide the VVs services listed in Table 3-1.

Table 3-1. HSF Network ISS VV Direct Link Services

Vehicle	Voice	Telemetry	Command	Video
Soyuz – Emergency	VHF	None	None	None
Progress	None	None	None	None
ATV	None	Return Link	Forward Link	None
HTV	None	Return Link	Forward Link	None
Dragon	None	Return Link	Forward Link	None
Cygnus	None	Return Link	Forward Link	None
* Crew Capsule (CC)	TBD	TBD	TBD	TBD
* Dragon Crew	TBD	TBD	TBD	TBD
* Dream Chaser	TBD	TBD	TBD	TBD
* CST-100	TBD	TBD	TBD	TBD

* Support Assumption – Integrated Network Communications are needed for Crew Safety & Mission Success

3.1.4.3 Visiting Vehicle Proximity / Attached Operations Links

Radio communications between the VVs and Space Station as well as hard-line interfaces during attached operations provide communications and mission services for VVs. During proximity operations the radio relay provides, voice, telemetry, command and video through the USOS-TDRS links, WSC and MCC-H and VV control centers connected to MCC-H processors through the Ground Segment Gateways. The specific ISS proximity and ISS attached operations services vary based on the specific vehicle capabilities and support requirement. Table 3-2 shows the VV and the services provided through the proximity or attached USOS, WSC and MCC-H interfaces.

For Soyuz undocking and return to Earth operations, the radio relay provides voice and telemetry data between the Soyuz crew on a best effort basis. Radio relays voice communications between the Soyuz, Russian Orbital Segment, USOS, TDRS, MCC-H, and Ground Segment MCC-M provide communications from Soyuz undocking through reentry. Depending on the geometry and re-entry blackout, Radio Relay communications are provided on a best-effort-basis through Soyuz Module separation and parachute deployment.

VV Video services are centerline camera views relayed from the VV through the USOS K-band Return Link to MCC-H. Other cameras on the ISS are used to provide external views for situational awareness.

Voice services are voice communications with crewmembers on board the VV using communications relayed though the ISS USOS. Voice communications with crewmembers on board the ISS are provided during VV operations but are not considered visiting vehicle voice communications.

TDRS direct link services are scheduled and used for ATV proximity and docked operations. ATV does not have a proximity radio or attached interface for telemetry and command services via the USOS links.

Table 3-2. HSF Network ISS VV, USOS, MCC-H Services

Vehicle	Voice	Telemetry	Command	Video	Proximity Link	Hard Line
Soyuz	X	None	None	X	X	None
Progress	None	None	None	X	X	None
ATV	None	None	None	X	None	None
HTV	None	X	X	X	X	X
Dragon	None	X	X	X	X	X
Cygnus	None	X	X	TBD	X	X
* Crew Capsule (CC)	TBD	TBD	TBD	TBD	TBD	TBD
* Dragon Crew Configuration	TBD	TBD	TBD	TBD	TBD	TBD
* CST-100	TBD	TBD	TBD	TBD	TBD	TBD
* Dream Chaser	TBD	TBD	TBD	TBD	TBD	TBD

* Support Assumption – Integrated Network Communications are needed for Crew Safety and Mission Success

3.2 NASA Centers Supporting the ISS Program

3.2.1 Johnson Space Center

3.2.1.1 Space Communications Integration Office

MOD SCIO primary role is to manage several operations tasks at JSC in support of HSF Programs. These include space communications operations integration with other NASA Centers and DoD elements providing networks and communications support to the ISSP, and MPCV. This office establishes and defines the working relationship between the MCC-H and external tracking and communications support providers. The office coordinates and integrates space communications mission and data service requirements among Space Operations and Exploration Systems Programs and between NASA Centers, and is responsible within MOD for mission support readiness reviews. Figure 3-1 shows the JSC SCIO management structure supporting the ISSP. Figure 3-2 shows the JSC SCIO operational interface structure for ISSP.

3.2.1.2 Reports

JSC, in their relationship with GSFC, will provide the following reports:

a. NOIT – Planned ISS Significant Event Dates.

1. VV launch, landing and docking/un-docking dates.

2. Extravehicular Activity (EVA) Dates.

3. Increment Start and end Dates.

4. Other Significant Events.

b. NOIT – Flight Readiness Review (FRR) Topic, Dates and Certification Endorsement Criteria.

c. NOIT – Summary Report (Bi-weekly).

d. Ground Controller – Network Critical Periods and times for ISS events.

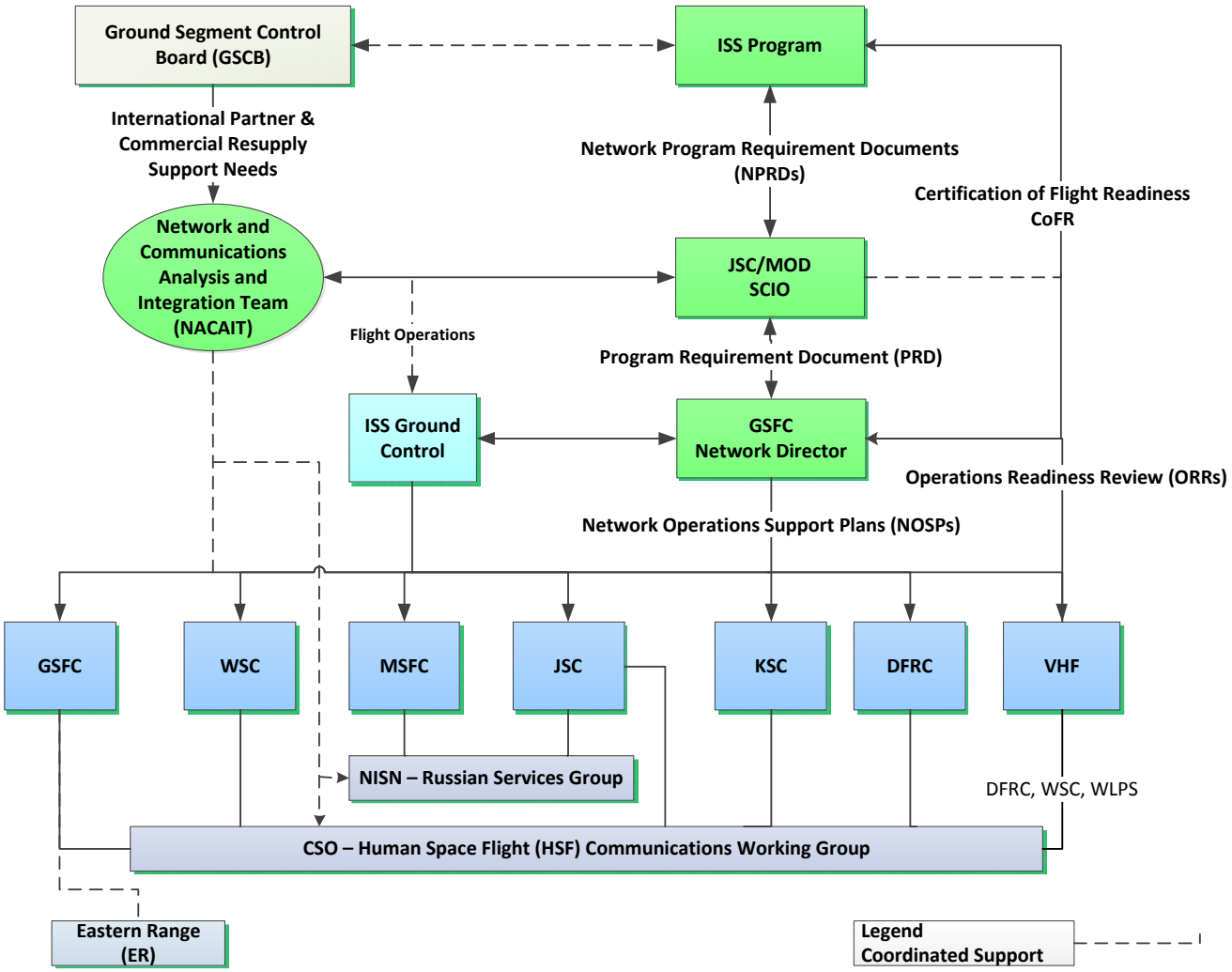


Figure 3-1. JSC SCIO Management Structure for ISSP

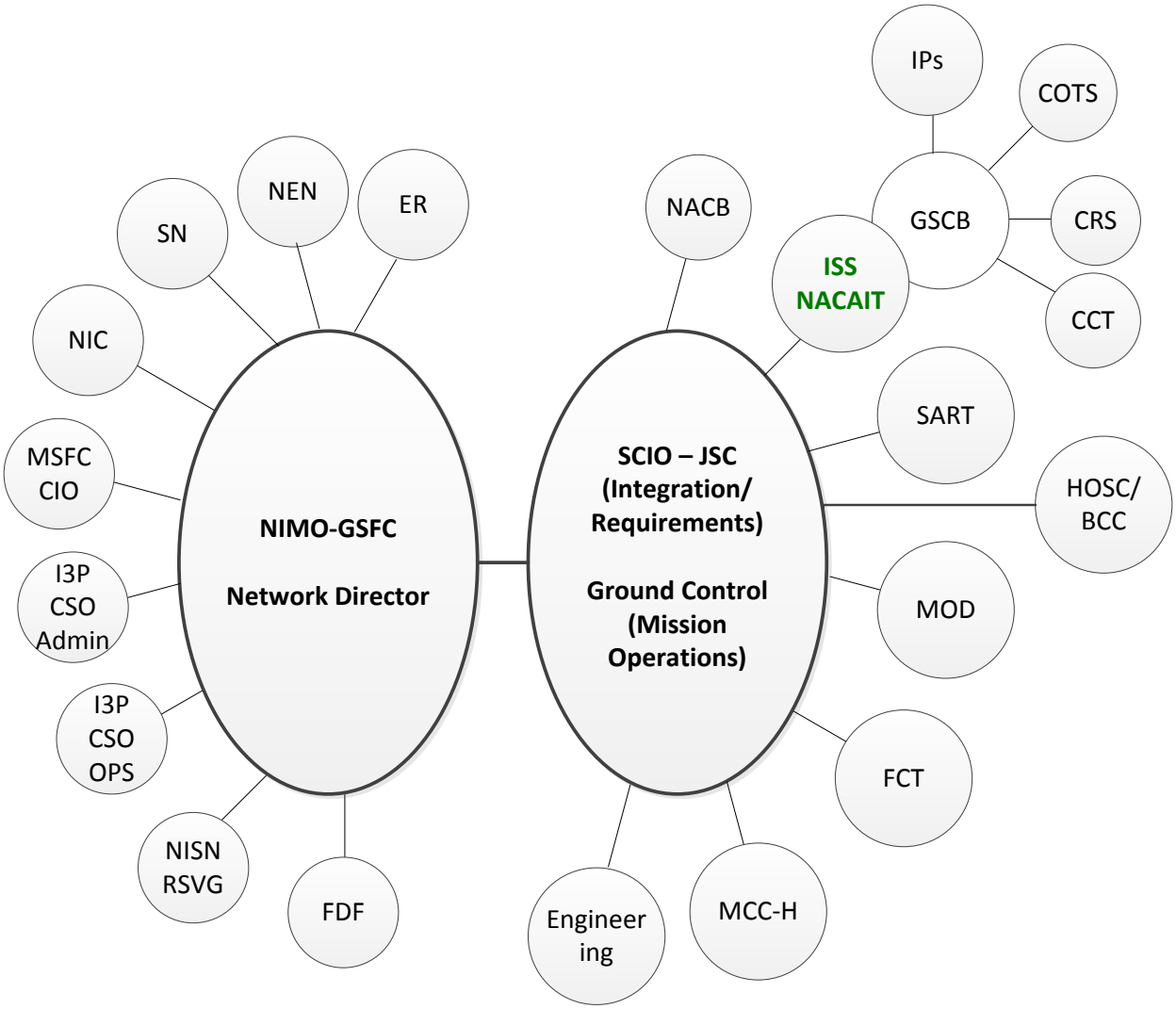


Figure 3-2. JSC SCIO Operational Interface Structure Supporting the ISSP

3.2.1.3 Mission Control Center

The MCC-H is the focal point for managing ISS activities and the integrated planning of real-time operations; the management of space systems operations; and the overall operational command and control of the ISS. MCC-H coordinates and integrates the TDRS communication for USOS, VVs, and International Partner systems operations. MCC-H also provides the principal gateway and ground segment interfaces with the International Partners and VV control centers. This coordination includes defining critical operations and operations support periods.

3.2.2 JSC Scheduling – HSF Network for ISS

a. JSC Scheduling Office is responsible for scheduling MCC resources. The office accepts requests for support of MCC resources and allocates this support in the form of a weekly MCC schedule. The Ground Control (GC) office collects inputs and formulates the MCC scheduling request. The GC office also receives planned Network outage notifications to formulate and distribute a work plan of outages and impacts for the ISS flight control team, operations planners and International partners.

b. Figure 3-3 illustrates the interaction used to schedule Integrated Network elements for ISS mission operations. The GC uses the flight plans and Joint Operations Panel (JOP) interactions to define the TDRS event coverage as well as critical events to formulate and submit the SN requests using the Space Network Access System. The GC receives the confirmation or conflict response from SN Scheduling and works with the flight control team to resolve conflicts. The GC also works with the flight control team to provide NASA ground site VHF support requests as well as ER C-band tracking station support requests for VV tracking to the Goddard SMM. The SMM works with the NEN Scheduling and ER Scheduling to schedule the specific ground station passes.

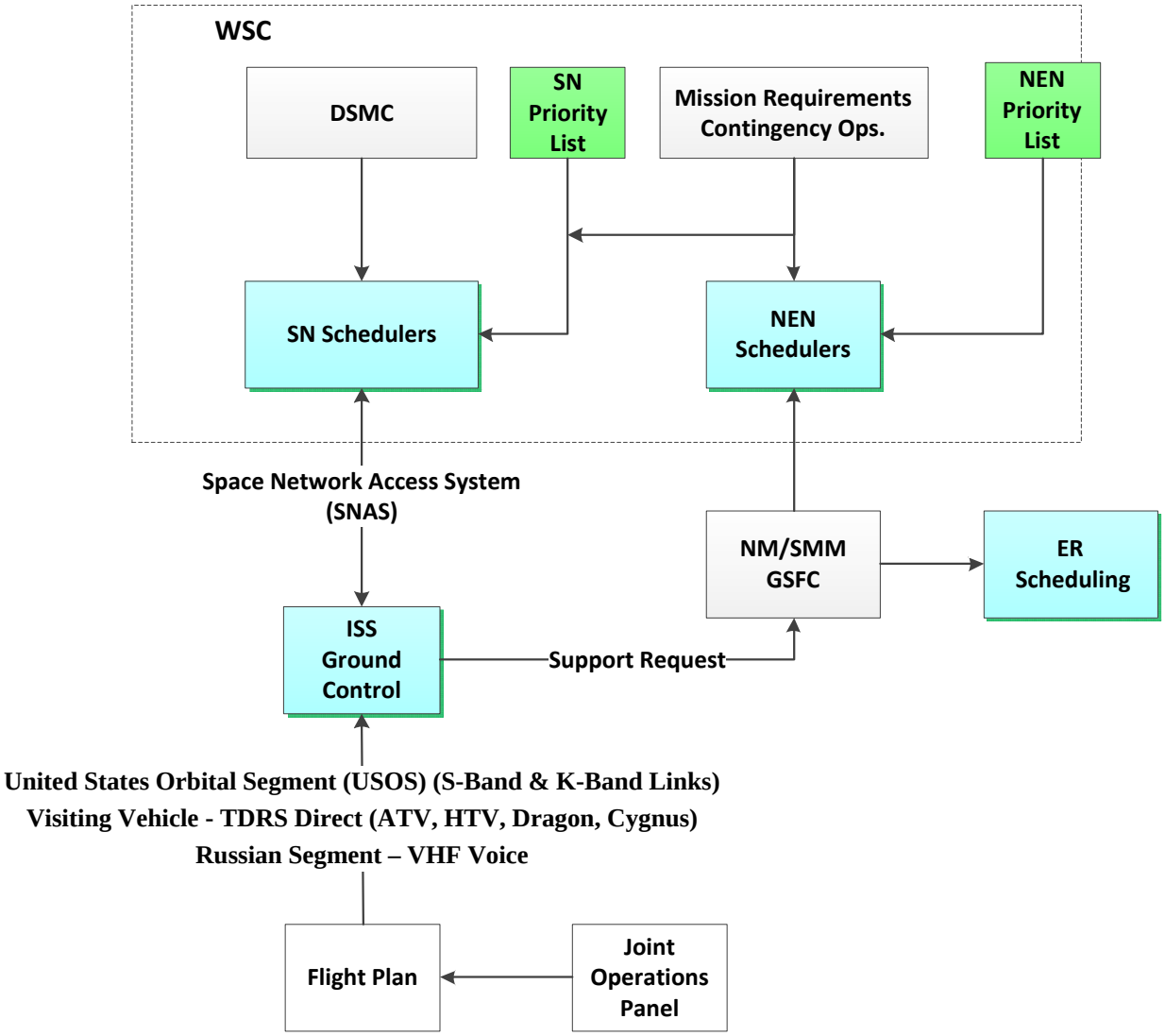


Figure 3-3. JSC – Network Scheduling – ISS

3.2.3 Goddard Space Flight Center

3.2.3.1 General

The GSFC provides T&DA support for the ISSP. Figure 3-4 shows the GSFC management structure for supporting ISSP activities. GSFC, in their relationship with JSC, will provide the following reports and/or documents to JSC:

a. Network Forecasts.

b. Anomaly Reports.

c. Significant Event Reports.

d. Weekly Contractor Status Reports.

e. Integrated Network Daily Reports, during missions.

f. Post Mission Anomaly Summaries.

g. Engineering Reviews.

h. ORRs.

i. FRRs.

3.2.3.2 Network Director

The GSFC ESC has assigned a ND the responsibility of managing overall T&DA activities in support of the ISSP. These activities include advanced mission planning, network interfaces, requirements management, and documentation development. Through ESC Working Groups, the ND establishes operational guidelines, documents support requirements, and obtains support commitments. The ND is the coordinator of GSFC T&DA activities and maintains a close working relationship with mission Program elements at GSFC and JSC SCIO to address ISSP issues on a continuing basis. The ND also interfaces with each element of the Integrated Network including the NIC, SN, MSFC, VHF Ground Stations, CSO Mission Services, and those elements providing network support services to the ISSP.

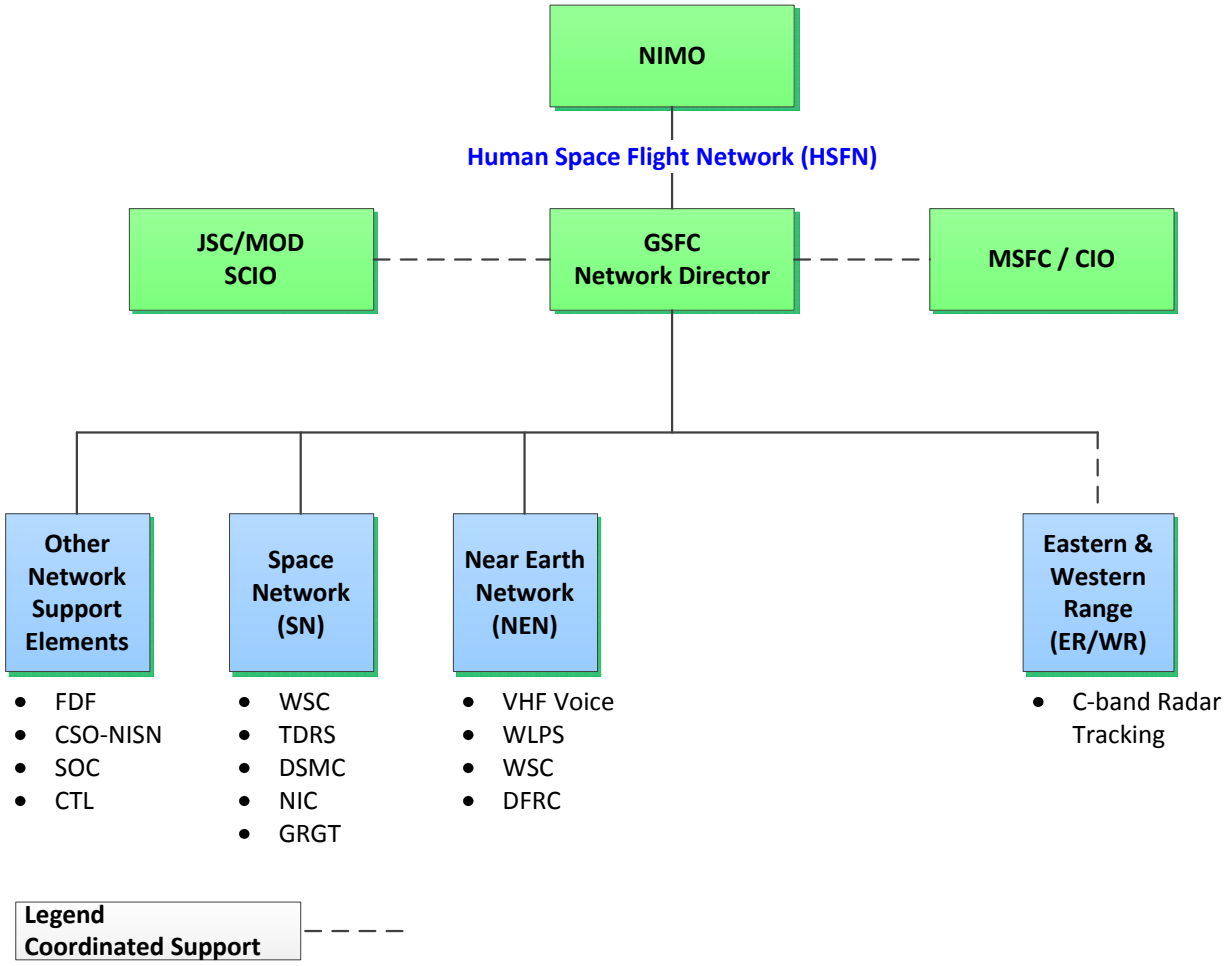


Figure 3-4. GSFC Structure for Supporting the ISSP

3.2.3.3 Space Network

3.2.3.3.1 General

The SN is the primary support element for overall ISS T&DA activities. The SN is supported by two ground stations located at the WSC in New Mexico(WSGT and STGT), and the ground station located at Guam (GRGT). ISS operations require SN T&DA support of the USOS S-band and K-band forward and return links as well as T&DA support of the ATV, HTV, CRS Vehicles, and Commercial Crew Vehicles.

3.2.3.3.2 White Sands Complex

The WSC processes, monitors, and routes data flowing between WSC and the common carrier communications links. The common carrier links, primarily operating through terrestrial communication links, transport data and control and status signals between WSC, JSC, MSFC, KSC, and GSFC. WSC records data that exceeds the data rate capabilities of the communication link, spacecraft data in the event of communication link/line failures, spacecraft data for systems/data link reliability studies and video (TV).

3.2.3.3.3 Tracking Data Relay Satellites

The space segment of the SN consists of a geostationary array of TDRSs that function interactively with the ground segments to provide KSA, SSA, and S-band Multiple Access (MA) forward, return, and tracking telecommunications services between the ISS and ground-based control and data processing facilities.

3.2.3.4 Network Integration Center

The NIC (located at GSFC) houses several NEN and SN remote network workstations, which are interfaced to the WSC NCCDS. The ND, NM, SMM, and GSFC test personnel monitor specific NEN and SN operations. NIC operations include SN and NEN (VHF) testing functions, ISS on-orbit operations, and other specified monitoring functions. The ND monitors critical mission operations and provides direction to the Integrated Network elements as required. The SMM monitors operations and provides direction to the Integrated Network elements in the ND's absence.

3.2.3.5 NEN Support

The NEN stations at WSC, Wallops Ground Station (WGS), and DFRC will provide VHF support for the SM VHF-1 and Soyuz VHF-2, as scheduled, for the bi-directional transmission of mission critical data packets or voice. The support is to include a VHF site voice coordination loop with the capability to uplink and downlink Space-to-Ground VHF communications between the MCC-H, MCC-M, and the ISS via WSC, WGS, and DFRC, as scheduled.

3.2.3.6 Flight Dynamics Facility

a. The GSFC FDF will provide the Space Station Control Center (SSCC) with TDRS state vectors for ISS-to-TDRS and VV-to-TDRS pointing computations. TDRS state vectors for VVs support will be supplied by the SSCC to the ESA and JAXA control centers via the JSC gateways as required. State vector formats are specified in JSC 11534, Vol. 1, *External Interface Control Document for JSC-GSFC Operational Communications ICD for Mission Control Center Systems*.

b. The GSFC FDF will provide the ISS, and VV acquisition data for TDRS to the WSC in a format as specified in JSC 11534, Vol. 1. There are no current plans to provide TDRSS acquisition data for Soyuz support.

c. The GSFC FDF will provide C-band acquisition data, Two-Line Elements (TLE), and line summary data during the pre-launch and early orbit phase of manned Soyuz missions docking with ISS.

d. The GSFC FDF will provide TLEs and line summary data on a scheduled basis while the Soyuz is docked to ISS.

3.2.3.7 CSO/NASA Integrated Services Network

The MSFC is responsible for managing the NISN. A description of the NISN is included in paragraph 2.6.2. The MSFC management structure for supporting the ISS includes a Customer Interface Group, Business Management Group, Network Services Group, and IT Security (See Figure 2-6).

The CSO is NASA's telecommunications provider. The mission of the CSO is to provide cost-effective WAN telecommunications services for transmission of data, video, and voice for all NASA Enterprises, Programs, and Centers utilizing commercial capability wherever possible. In support of the ISS, CSO provides the communications between WSC, JSC, MSFC, KSC, and GSFC through the common carrier facilities. The NISN Government Furnished Equipment (GFE), and Multiplexer/Demultiplexer (MDM) are used for the channelized digital traffic between WSC and JSC. The Closed Internet Protocol Operational Network (IONet) provides connectivity from JSC/WSC to GSFC and MSFC as well as other NASA centers. Video and voice are also extended. The VSS provides long line connectivity to the other NASA centers and the Voice Distribution System (VDS) provides local connectivity on GSFC. For the purposes of this document, the NISN is considered a supporting element of the Integrated Network.

3.2.3.7.1 NISN Russia Services Group

The CSO/NISN Russia Services Group (RSVG) provides project management, planning, engineering, installation, implementation, and sustaining informational technology and telecommunications services for NASA Programs and Projects within Russia.

3.2.3.8 Simulation Operations Center

a. The SOC, located at GSFC Building 25, builds spacecraft simulators, data formatters, and other equipment needed to test NASA NEN telemetry subsystems, SN telemetry

subsystems, and MOC interfaces. Test services are provided in the form of spacecraft simulations and compatibility tests and are provided by resident simulator systems built on Motorola and Intel based computers. This provides ETE (spacecraft to experimenter or end user) simulations and tests needed to verify the readiness of the Project and/or the voice and telemetry networks needed to support the mission. These systems also provide the flight operations personnel a platform to test procedures for validity and conduct Launch and orbital proficiency training.

b. For ISS support, the SOC will act as a substitute for the JSC MCC if the ESTL is not available. Also, the SOC has simulated the ATV Control Center during ground systems testing, flowing command data and receiving telemetry.

3.2.3.9 Compatibility Test Laboratory

The CTL, located at GSFC Building 25, can support RF compatibility testing of both NEN and SN user customers. The RF shield room can accommodate a user's transponder, transceiver, or transmitter along with the Command and Data Handling (C&DH) equipment. The CTL has access to an antenna system designed to support TDRSS relay testing with WSC. The CTL is also interfaced via single-mode fiber optics to the spacecraft test and assembly areas in the Building 7/10/29 complex at GSFC to allow for RF compatibility testing of fully-integrated spacecraft. In support of the ISS, the CTL provided an equipment rack of CTL/Compatibility Test Van (CTV) equipment which was shipped to Europe and was used to test the Early Communications (E-COMM) prototype, and was also employed in the functional and performance tests conducted with the Flight Model ATV integrated avionics system in Europe. The transportable CTV, deployed from GSFC, can interface a spacecraft under test with TDRS and WSC. This unit can send spacecraft telemetry data via the NEN, SN, and NISN to all support elements, and can also be used as a data source for performing network verification tests.

3.2.4 Kennedy Space Center - TBS

3.2.5 Marshall Space Flight Center

3.2.5.1 Huntsville Operations Support Center

The MSFC Operational Structure Supporting the ISS is illustrated in Figure 3-5 and includes the POIC, Tele-Science Center (TSC) interfaces BCC.

a. The HOSC is a multi-program support facility that hosts the POIC. The POIC manages the operation of on-orbit ISS payloads and payload support systems in coordination with the NASA MCC-H, the globally distributed International Partner Payload Control Centers (PCC), TSC, and individual payload user facilities. The POIC is comprised of the Payload Data Services System (PDSS), the Enhanced HOSC System (EHS), the Payload Planning System (PPS), Mission PC Services (MPS), and the Enhanced Mission Communications System (EMCS). PDSS acquires, stores, and distributes ISS data to the EHS, International Partners (IP), TSCs, and other payload user facilities. The EHS processes payload commands and telemetry for pre-launch integration and checkout, simulation training, and flight operations. The HOSC contains the USOC, a

facility where payload users can come to control and monitor the operations of their onboard payloads.

The HOSC also hosts the BCC designed and managed to allow for activation in the event of an unpredictable, immediate loss of the MCC-H or a planned evacuation of MCC-H. The HOSC BCC replicates the MCC-H functionality to sustain core systems through the USOS links, International Partner control center telemetry, command, voice and video interfaces. HOSC BCC also provides ESA and JAXA International Partner and WSC interfaces to sustain TDRS direct link interfaces and services for the ATV and HTV VVs.

b. Figures 3-5 and Figure 3-6 illustrate the TSC) interfaces.

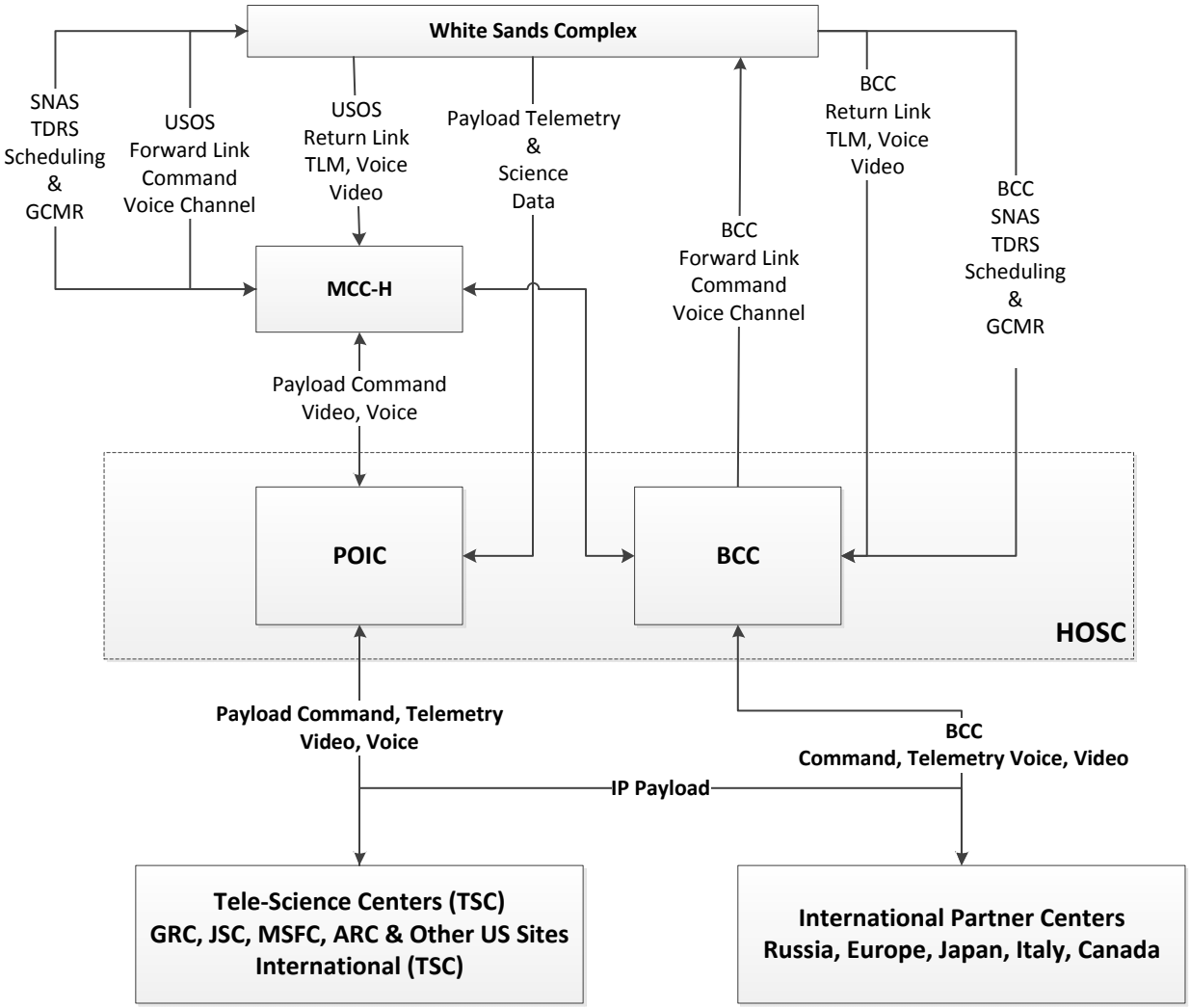


Figure 3-5. MSFC Operational Organization Supporting the ISS

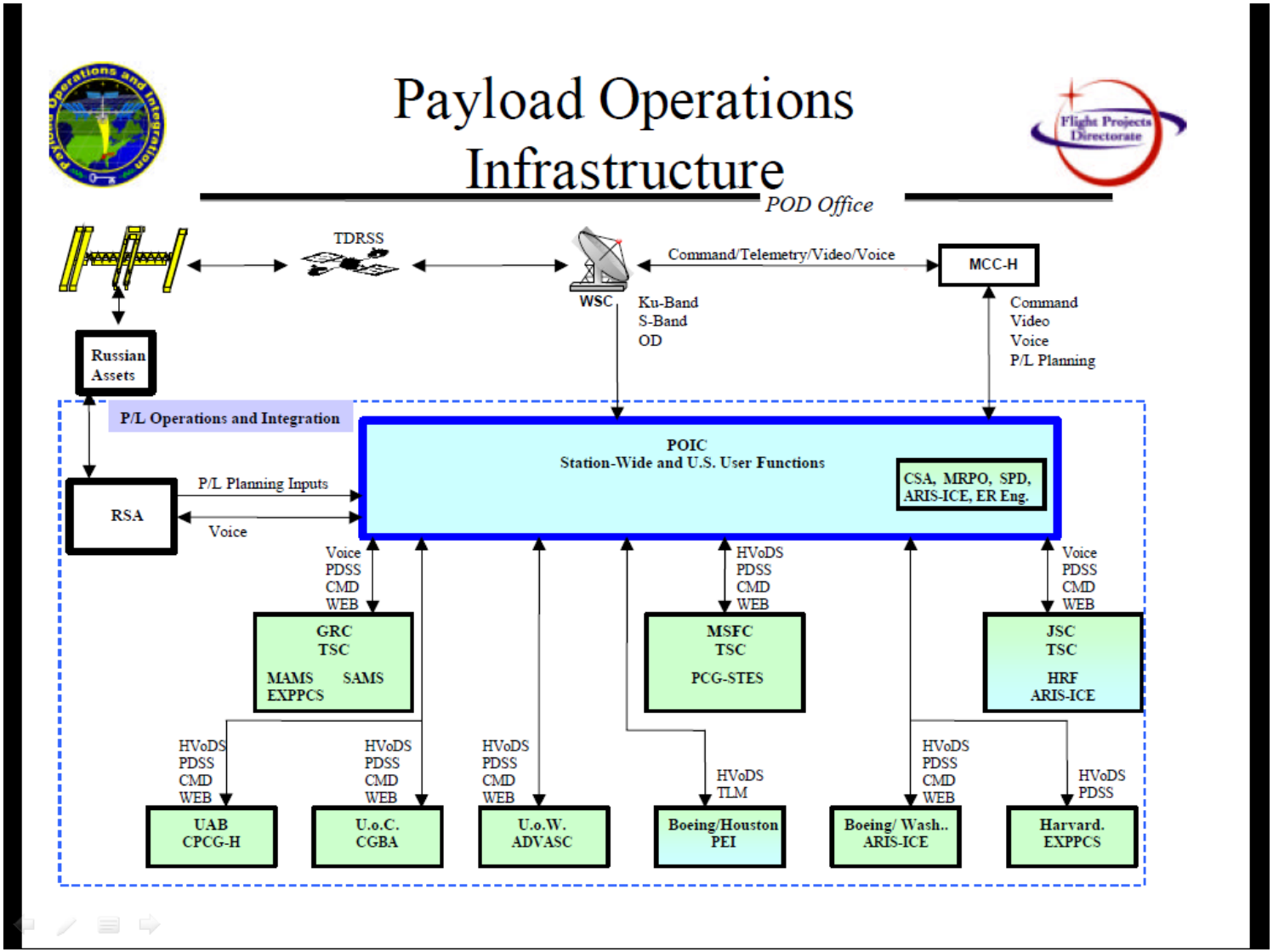


Figure 3-6. MSFC Operational Structure Supporting the ISS

Pre-Decisional, For Internal NASA Use Only

3.2.6 Glenn Research Center

The GRC at Lewis Field, in Cleveland, OH, provides Spectrum Management support to the ISSP. This primarily includes resolving RFI incidents that may occur during on-orbit operations of the ISS. RFI is the undesired reception of electromagnetic emanations of sufficient signal strength and proximity to a mission-assigned frequency and timeline to cause degradation or complete loss of data and/or voice communications. The GRC also serves as a point-of-presence in the TSC for supporting the ISS.

3.2.7 Eastern Range

The ER will provide C-band metric data support, tracking of VVs for the purpose of generating Integrated Network pointing and acquisition data. Generally, C-band tracking data is used for new vehicle operations until the vector transfer from the VV control center to the Goddard FDF via MCC-H is proven operational.

Section 4. Multi-Purpose Crew Vehicle

4.1 Overview

4.1.1 General

The MPCV is a Program to provide the capability for Human Exploration beyond LEO. MPCV will serve as the exploration vehicle that will carry the crew to space, provide emergency abort capability, sustain the crew during the space travel, and provide safe re-entry from deep space return velocities. The initial vehicle is based on the Orion spacecraft requirements. Orion is to be capable of conducting regular in-space operations (rendezvous, docking, and extravehicular activities), in conjunction with other payloads delivered by the SLS that will execute missions beyond LEO. Orion may also serve as a backup system for ISS cargo and crew delivery. JSC is designated as the lead center for MPCV with interactions with other centers.

4.2 Exploration Flight Test

4.2.1 General

Exploration flight tests are planned to verify or demonstrate MPCV systems and capabilities. EFT will also be used to build and baseline the processes and interfaces for MPCV Missions. These processes include the identification, verification, and implementation of support requirements, control panels, and working groups.

The first mission designated EFT-1 is to demonstrate the Orion vehicle high-energy re-entry (deep-space re-entry) heat shield performance and other objectives. To create the necessary trajectory a Delta launch vehicle is to be used to put an un-manned Orion Crew Module (CM) in a highly elliptical orbit with an apogee of approximately 4700 nautical miles. EFT-1 is a joint Lockheed Martin NASA effort.

4.2.2 MPCV Mission Phases

MPCV EFT-1 mission has five phases. Phase 1 is Assembly, Integration, and Processing (AI&P). Phase 2 is Ground Operations. Phase 3 is Mission Operations. Phase 4 is Landing and Recovery. Phase 5 is De-servicing Operations. For each phase, a designated owner, control panel, and working groups define and implement the requirements for that phase. Figure 4-1 illustrates the Mission Phase Owners and Process for EFT-1 support requirements. Figure 4-2 illustrates the HSF Network Integration of HSF Services for MPCV/EFT-1 Operations. The NOD assumption is that these panels and process will be used for future MPCV as well as SLS missions.

All support requirements, including the Integrated Network Requirements, for EFT-1 and future MPCV/SLS missions will be developed and documented in the Mission Support Requirements Document (MSRD). The SCIO will perform the MSRD book management activities through interactions with the requirement owner panels and supporting working groups. Once approved, the MSRD will drive the Automated Support Requirements System (ASRS) –PRD to implement the support requirements.

1. EFT-1 has 5 mission phases.
2. Each phase is "owned" by a working group or a WG Panel
3. Phase owners will develop / define Support requirements
4. Supporting working groups develop MSRD requirements too. Will coordinate inputs with phase owners.
5. Flight Test Management Office (FTMO) owns the document with SCIO being the book manager
6. Draft requirements evaluated within the team for validity and completeness. Review and de-conflict requirements. Establish asset availability and costs
7. Draft requirements are reviewed by an approval board. Approved rqmts forwarded for capture in PRD volumes. Disapproved rqmts get reworked or deleted from DPRD.
8. Bercon and Aquino partition approved requirements into their PRD volumes.
9. PRD owners coordinate and manage the inputs to the PRD data base.
10. Service providers authorized to acquire assets.

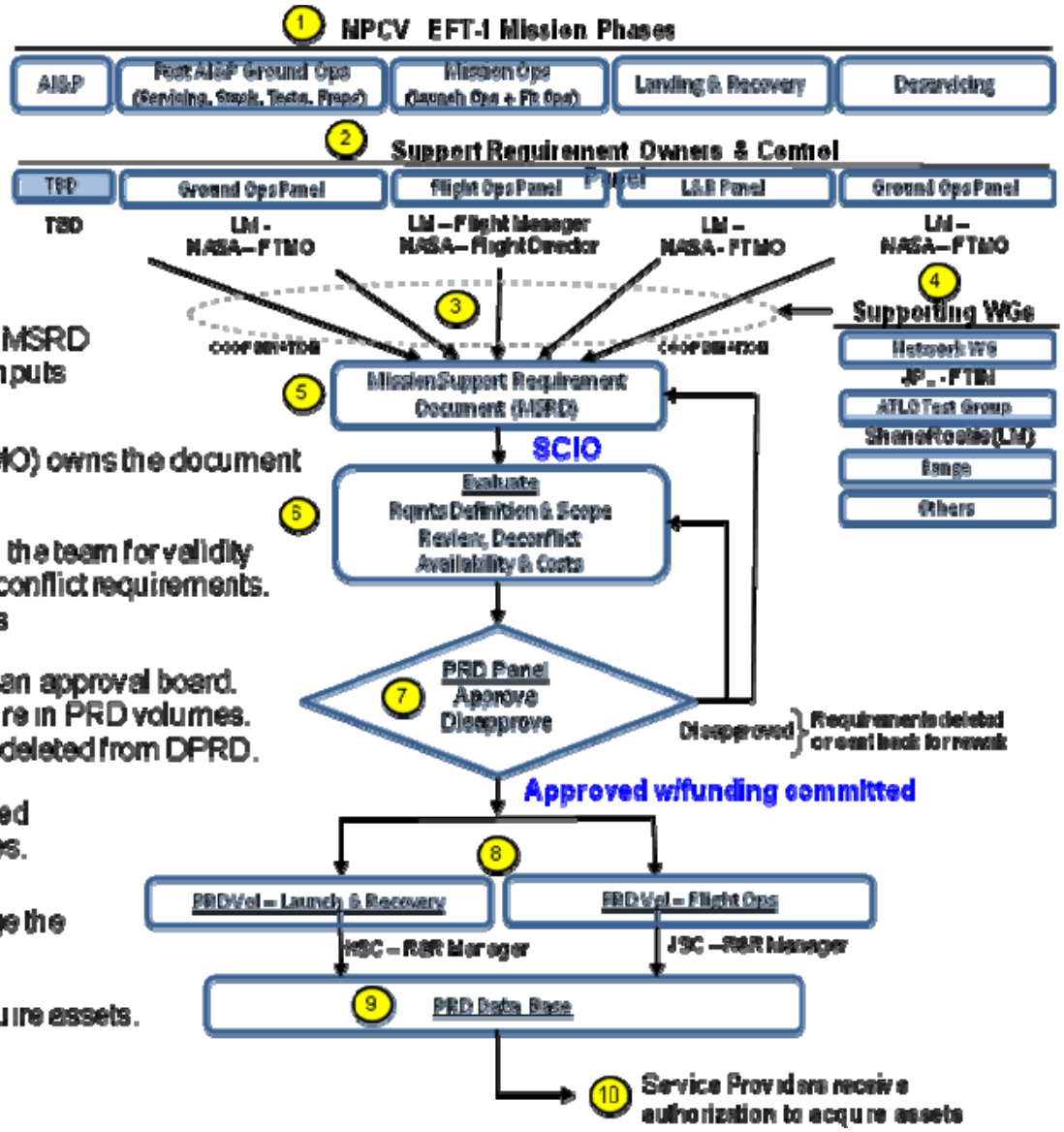


Figure 4–1. MPCV / EFT-1 – Mission Support Requirement Development Process

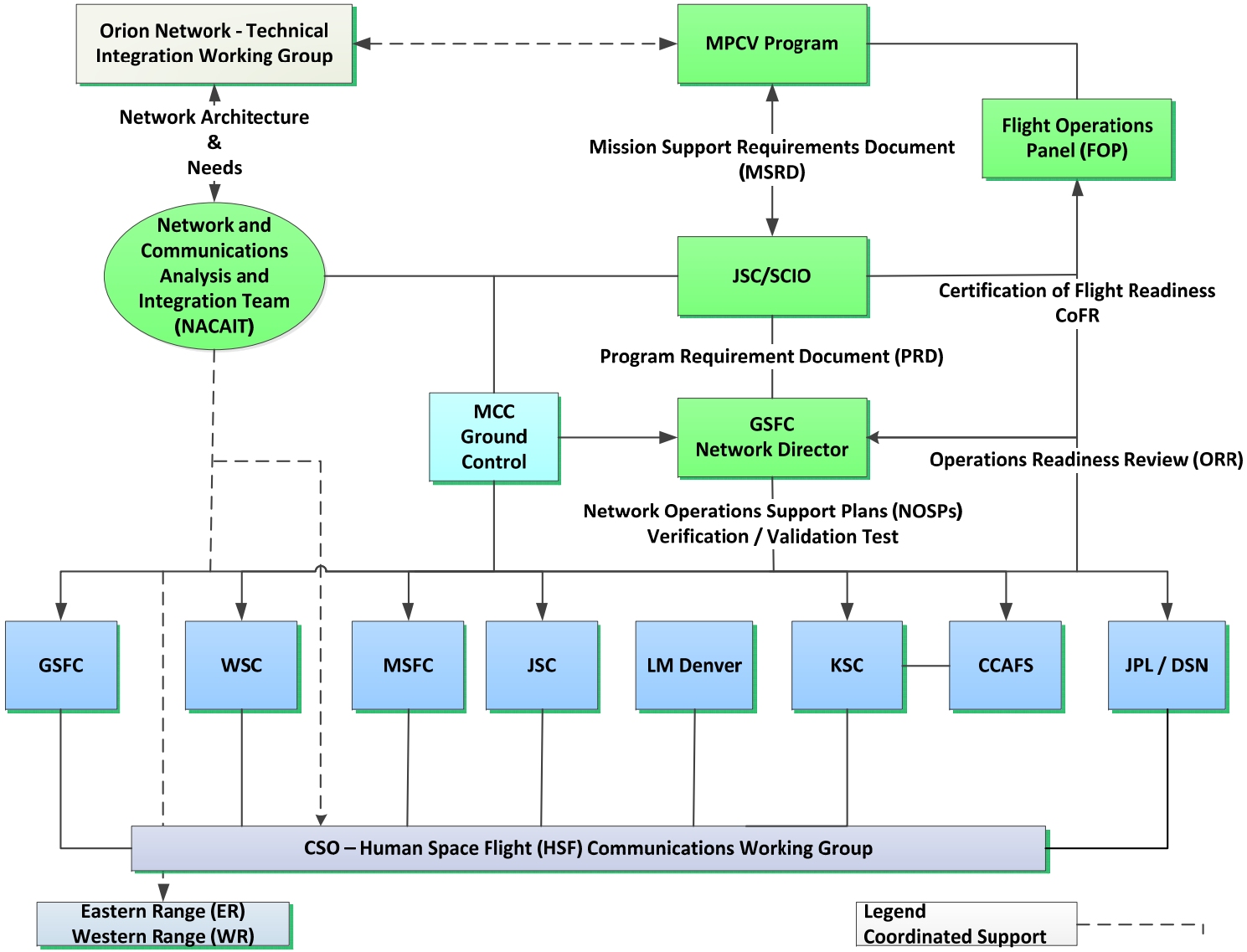


Figure 4-2. Integration of HSF Services for MPCV / EFT-1

Pre-Decisional, For Internal NASA Use Only

4.2.2.1 EFT-1 Assembly, Integration, and Processing Phase

The Crew/Service Module (CSM) test article will be assembled in the KSC Operations and Checkout facility. During this phase the CSM Vehicle – Network interface checkouts and end-to-end verification activities will be performed to verify the communications and mission data services function as expected. For EFT-1 these include Orion –TDRS Links, MCC-H and Orion Engineering Support Centers within the O&C and the LM Denver Facility. HSF Integrated Network interactions are through the ND, SCIO and GC and Network Working Group, Chaired by Flight Test Management Office (FTMO).

4.2.2.2 EFT-1 / MPCV Ground Operations Phase

This phase begins after the AI&P phase and consists of (CSM) hazardous servicing operations; Launch Abort System (LAS) mating; and transportation to and mating with the Launch Vehicle. During this phase ground umbilical, integrated network checkouts, and countdown rehearsals are performed to verify the interfaces, services and procedures function as expected to meet the support requirements.

For EFT-1 it is assumed that the assembled LAS/Orion Crew Module will be moved to Space Launch Complex # 37 (SLC-37) and stacked on the Delta IV launch vehicle. Network checkout activities will include verification of services with the Delta Operations Center (DOC), MCC and Orion Engineering Support Centers and the KSC O&C and LM Denver facility. The Ground Operations Panel (GOP) is empowered to make decisions, direct actions and bears the responsibility for the Ground Operations Phase. HSF Integrated Network interactions with the GOP are through the ND, SCIO and GC.

4.2.2.3 EFT-1 / MPCV Mission Operations Phase

This phase begins after the completion of the Ground Operations Phase and FRR. Figure 4-3 illustrates the EFT-1 Mission Operations Phase. Orion launch operations (pre-launch and countdown) will be conducted from the O&C Building at KSC while the Orion Flight Operations (ascent, orbit, and re-entry) will be conducted from the JSC MCC. The Design Reference Mission has an ascent phase, orbit, and entry phase with landing/recovery mission phase following re-entry. EFT-1 flight profile assumes an ascent phase of a Delta IV-Heavy launch with the payload being the Orion test article. The Orion – Integrated Network TDRS forward and return link acquisition of signal occurs during ascent after the Orion Service Module panel separation and LAS jettison during ascent. The Delta IV-H upper stage preprogrammed sequence, including attitude control, until Orion crew module separation just before re-entry. The inert Orion SM mockup remains attached to the Delta upper stage. After separation, the unmanned CM test article maneuvers to execute the reentry for splashdown in the Pacific Ocean – off the coast of San Diego, CA, where the Landing and Recovery phase begins.

The Flight Operations Panel (FOP) is empowered to make decisions, direct actions, bears the responsibility for the Mission Operations Phase, and interacts with the GOP and Landing Recovery Panel (LRP) for phase operations transitions. The Flight Director and EFT-1 Mission Manager chair the FOP. HSF Integrated Network interactions with the FOP are through the SCIO and GC.

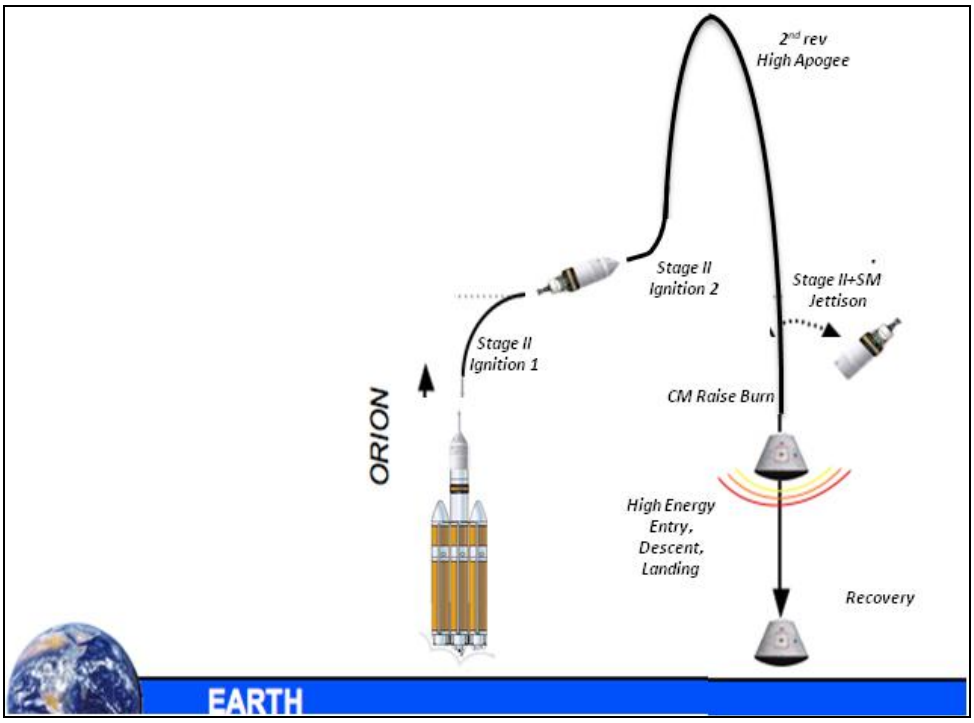


Figure 4-3. EFT-1 Mission Operations Phase

4.2.2.4 EFT-1 / MPCV Landing and Recovery Phase

This phase begins after the completion of re-entry during the Mission Operations Phase. Crew Module test article recovery is performed by a Navy well-deck ship and returned to the de-servicing facility in Long Beach, California. HSF Network support continues through the landing and recovery operations including Orion – TDRS Direct Link Communications used to monitor parachute deployment and post landing spacecraft configuration. HSF Network support also provides communication services with the landing and recovery elements.

The LRP is empowered to make decisions, direct actions, bears the responsibility for the Landing and Recovery Phase and interacts with the GOP and FOP for MPCV phase transitions. HSF Integrated Network interactions with the FOP are through the ND, SCIO and GC.

4.3 Goddard Space Flight Center – MPCV

4.3.1 General

The GSFC will provide tracking and data acquisition services, integrated testing, and communications integration for the Integrated Networks under the MPCV similar to what it has provided for past HSF missions.

4.3.2 Integration Process

The specific integration process and role of GSFC for MPCV is still in formulation.

4.4 Johnson Space Center (JSC) – TBS

4.5 Kennedy Space Center – MPCV, TBS

4.6 Marshall Space Flight Center – MPCV, TBS

4.7 Eastern Range – MPCV, TBS

4.8 Glenn Research Center – MPCV, TBS

4.9 Jet Propulsion Laboratory (JPL) – MPCV

4.9.1 Network Working Group

Activities of the Network Working Group provide technical leadership to integrate all activities related to designing and implementing Orion's end-to-end data network to successfully achieve the objectives of Exploration Flight Test 1 (EFT-1). The group's goal is to advocate and strive for excellence in system integrity and performance throughout the mission lifecycle, thereby ensuring a seamless transition from development to flight operations. This integration includes the spacecraft, launch vehicle and MPCV facilities. HSF Integrated Network interactions with the MPCV Network Working Group are through the SCIO NACAIT and the ND described in Section 2 of this document.

4.9.2 Deep Space Network – MPCV, TBS

Section 5. Commercial Crew Program

5.1 Overview

5.1.1 General

KSC is the lead Center for the CCP development with participation from the JSC for integration with ISS and crew flight operations. NOD assumptions are that HSF network support will be required for CCP flight operations to/from the ISS, these interactions will be defined as the project designs mature. Expectations are that interactions with the HSF network will mirror the processes established for the ISS, COTS, CRS and MPCV network services. As of December 2012 Space Act Agreements exist with the following commercial organizations, listed below in alphabetical order, for the commercial crew vehicle analysis and development phase. This NOD assumes that the space act agreements will define the HSF Network support requirements using the processes established for ISS Visiting Vehicles

Alliant Techsystems, (ATK) – Liberty Rocket

Liberty rocket will be comprised of a five-segment solid booster first stage and hydrogen-fueled second stage, currently used for the second stage of Europe's Ariane 5. Liberty is to be launched from KSC Space Launch Complex #39. Liberty will be capable of delivering Commercial Crew or Cargo Vehicles to LEO.

Blue Origin – Crew Transport System (CTS)

CTS is comprised of a Space Vehicle (SV) Space Vehicle capable of carrying seven astronauts and will transfer NASA crew and cargo to and from the International Space Station (ISS). Atlas V launch from CCAFS V SLC-41 is to be used for CTS.

Boeing – Crew Space Transportation 100 (CST-100)

CTS-100 spacecraft design is in collaboration with Bigelow Aerospace to transport crews to the International Space Station. CST-100 would be able to support larger crews of up to 7 people. Atlas V launch from CCAFS V SLC-41 is to be used for CTS-100.

Sierra Nevada Corporation (SNC) – Dream Chaser

The Dream Chaser is based on NASA's HL-20 lifting body design and planned to carry seven people to and from low earth orbit/ISS. Dream Chaser is to be launched on the Atlas V launch vehicle and land horizontally on conventional runways.

Space Exploration Technologies (SpaceX) – Dragon Crew Configuration

Dragon Cargo vehicle modified to transport 7 crew members to the ISS. The Dragon crew is to be launched on the SpaceX Falcon 9 launch vehicle from CCAFS SLC-40.

Section 6. Network Planning and Coordination

6.1 General

Several groups and organizations have been established and chartered to facilitate effective management of the planning and coordination of all HEO. These groups include the Flight Techniques Panel (FTP) Joint Operations Panel (JOP), Network Support Group, MCWG, NACAIT, Human Space Flight Communications Working Group (HSF CWG) and Technical Interchange Meeting (TIM). Figures 6-1 through 6-5 illustrate the groups/teams that plan and coordinate HEO Mission Support.

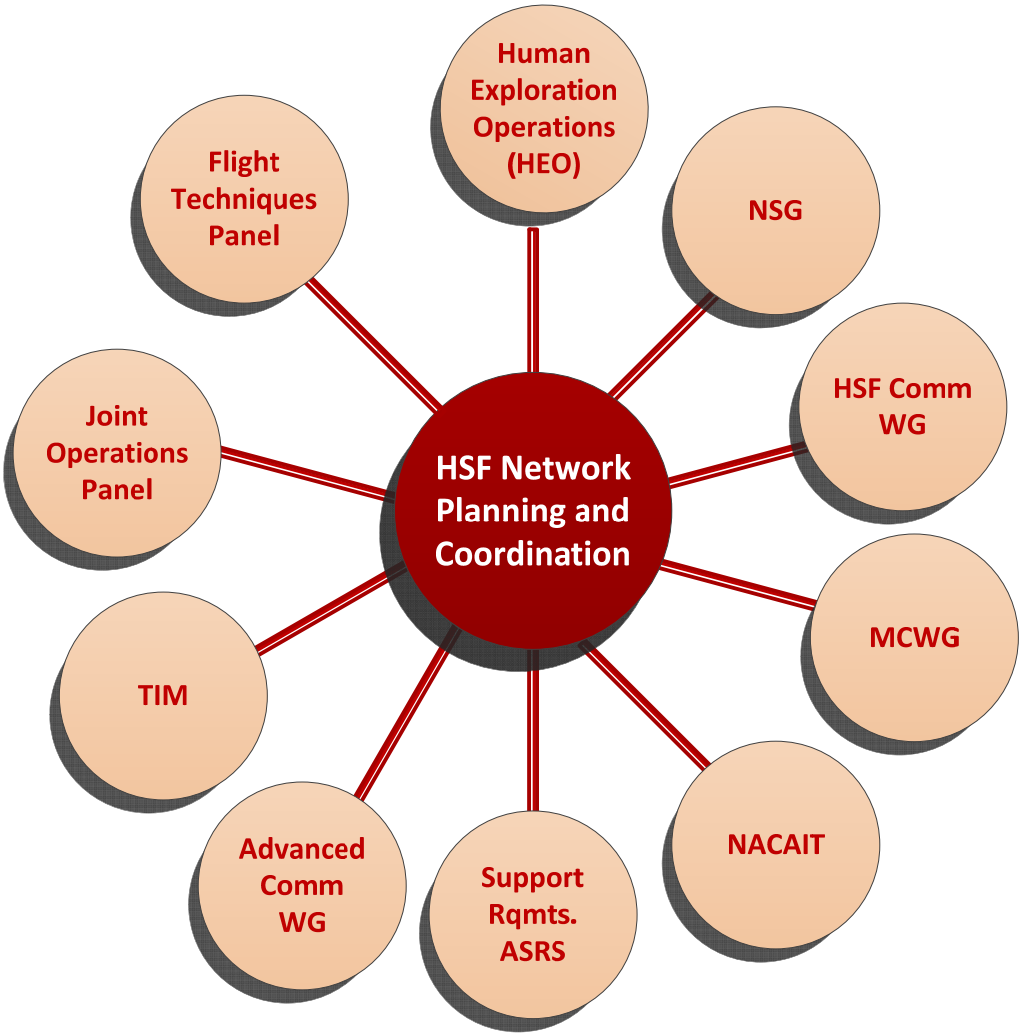


Figure 6-1. Network Planning and Coordination of HEO Support

Figure 6-2. Network Planning and Coordination Supporting ISS

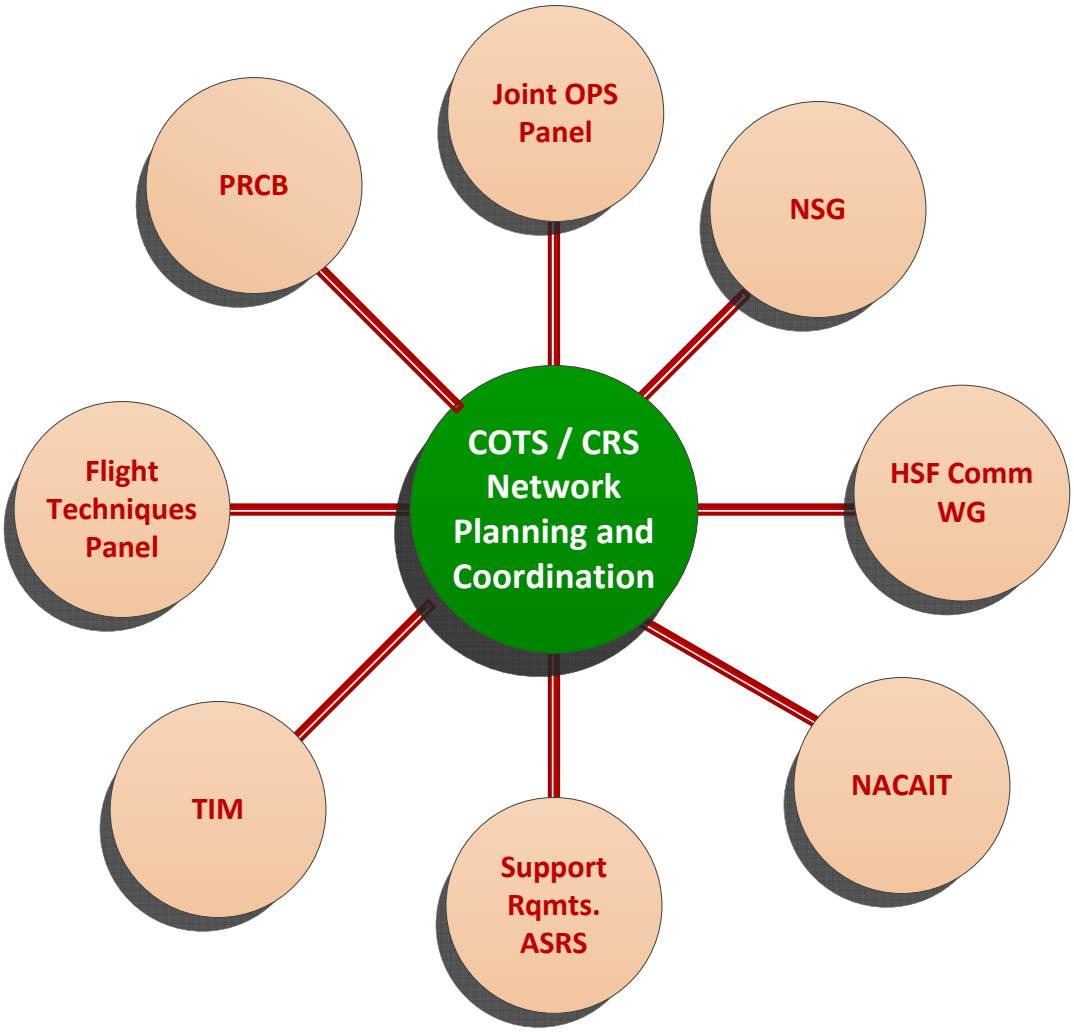


Figure 6-3. Network Planning and Coordination Supporting COTS / CRS

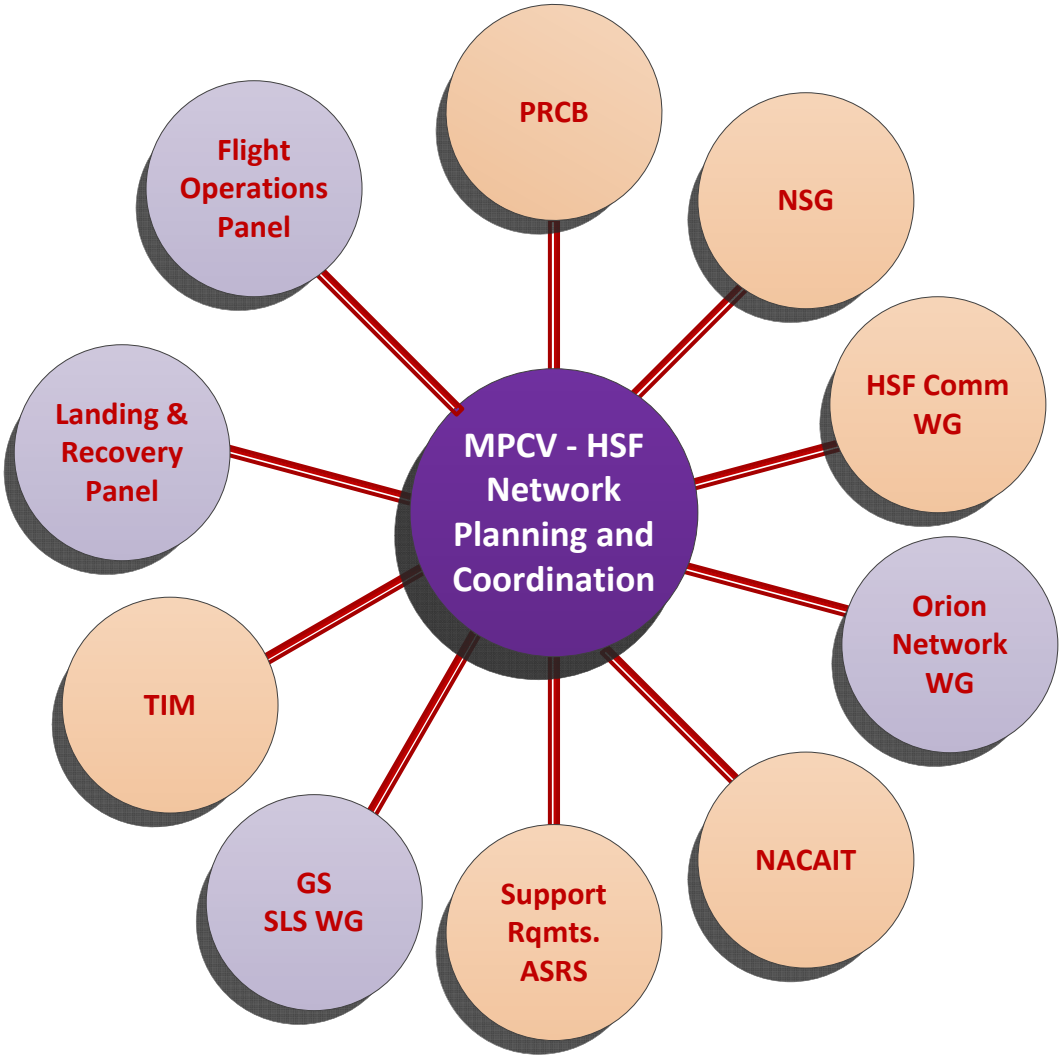


Figure 6-4. Network Planning and Coordination Supporting MPCV

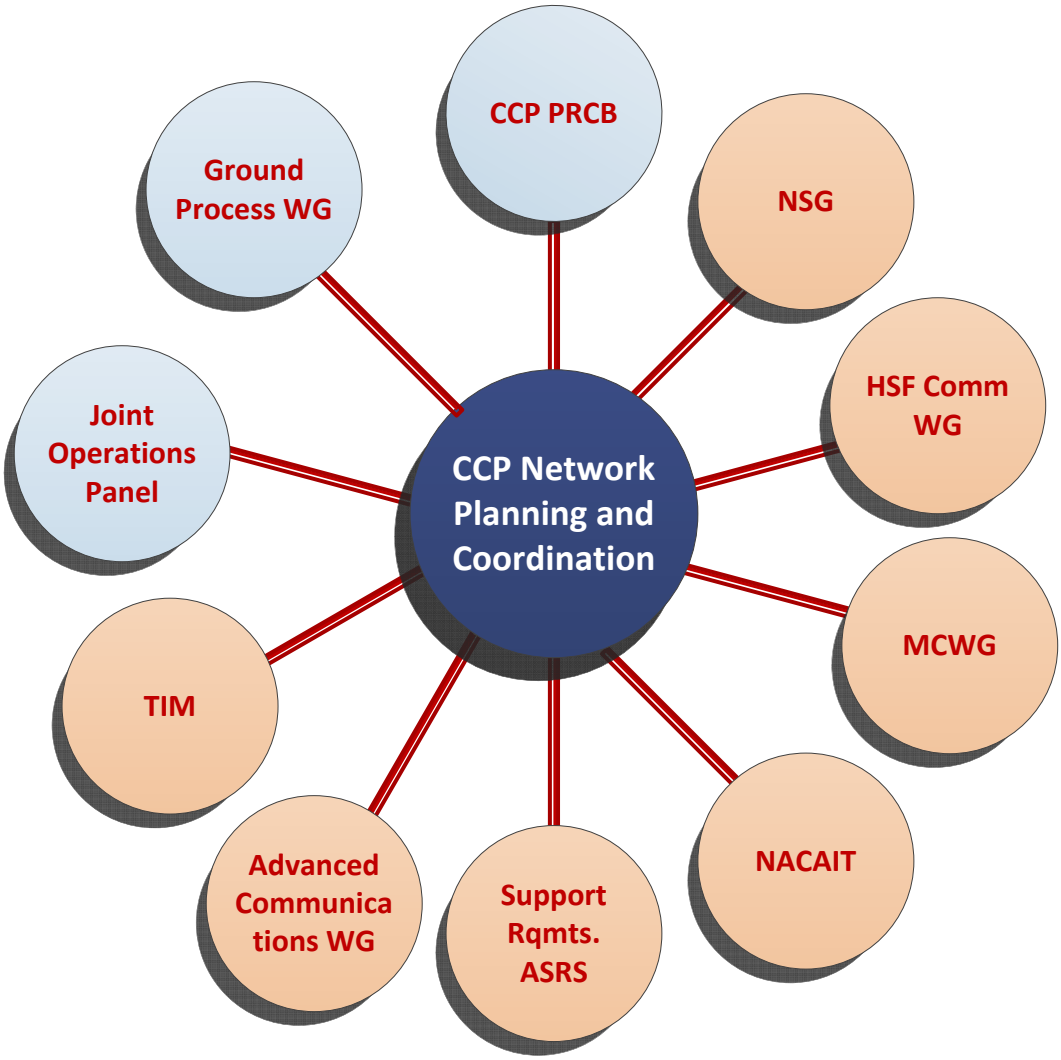


Figure 6-5. Network Planning and Coordination Supporting Commercial Crew Program

6.2 Group and Organization Descriptions

6.2.1 Advanced Communications Working Group

The Advanced Communications Working Group led by the ISSP, addresses the requirements for new communications capabilities on the Station and the concepts that may satisfy those requirements. All Station communication systems are considered, including those of the International Partners and space vehicles that dock to the Station. Ground data processing facilities that support the onboard communication systems are also examined along with the TDRSS and its ground station at White Sands. Participants from all major NASA field centers dealing with space communications join in with interested contractors during the weekly teleconferences.

6.2.2 Ascent/Entry Flight Techniques Panel

The Ascent/Entry Flight Techniques Panel (AEFTP) provides a forum within the JSC/MOD for integrating and coordinating the efforts resulting in the development of the flight techniques for trajectory, attitude control, and management of avionics and other systems. Additionally, they will make recommendations to the responsible Program elements and propose hardware and software changes that are designed to improve these operations. The AEFTP includes membership from JSC, GSFC, KSC, MSFC, DFRC, and the DoD. Participation is on an "as requested" basis.

6.2.3 Automated Support Requirements System

The Automated Support Requirements System (ASRS), managed by KSC, is used to communicate HSF requirements and responses among centers/agencies supporting the ISSP, MPCV, and COTS. Refer to paragraph 7.2 for additional information related to ASRS.

6.2.4 Ground Segment Control Board

a. The GSCB, chartered by the ISSP and managed by JSC, was established to manage the baseline for ground facilities requirements and interfaces, to disposition changes affecting that baseline, and to make decisions on requirements issues that cannot be resolved by line organizations or implementation teams. The intended area of cognizance is within the ISSP including NASA and International Partner facilities. This does not include vehicle development ground facilities. The GSCB approves the disposition of changes to documents under NASA baseline control and under bilateral or multilateral baseline control. The GSCB manages the development and maintenance of ISSP Operations concepts related to ground segment processes and defines them in the appropriate sections of the Station Program Implementation Plan (SPIP).

b. The GSCB controls all delegated program documentation related to ground segment policies, concepts, processes, plans, and requirements associated with specifications for ground systems, Program-level ground system interface control, Program-level ground system test and verification plans, and Program-level ground segment telecommunications plans.

6.2.5 HSF Communications Working Group

The HSF Communications Working Group, chaired by the CSO/NISN Customer Interface Group (CIG) representative, was established to coordinate all aspects of WAN service implementation in support of HSF missions. Members include NISN System Managers (NSM), NISN CSR, WAN Systems Engineering, JSC Systems Engineering, JSC Voice Control, KSC Voice Control, and the MSFC GSRT.

6.2.6 Mission Communications Working Group

a. The MCWG, led by GSFC, is a forum for mission communications operations and engineering personnel from the NASA, DoD, and other agencies supporting the ISSP and other approved national and international space programs, to coordinate their communications operations activities, (i.e., system and/or service utilization, service activation and acceptance testing, procedures development, service restoration and troubleshooting techniques, system analysis, and technical interchanges.)

b. The MCWG identifies and resolves communications problems from both an operations and engineering discipline aspect. The combined experience and expertise of this group is invaluable in identifying program needs and developing ways and means of satisfying requirements. Mission communication requirements identified by the MCWG are only recommendations and are forwarded to the appropriate review boards of the affected agencies for validation.

6.2.7 Network and Communications Analysis and Integration Team

a. The NACAIT, led by JSC, was established by the ISSP Office (ISSPO) and is responsible for gathering, development, and documentation of all ISS operational support communications requirements. This includes all ISS communications elements that require NASA communications resources. The NACAIT membership includes various NASA-wide organizations that support the ISSPO.

b. In the ISSPO Integrated Product Team (IPT) structure, the NACAIT reports to the GSCB Ground Systems IPT. Leadership of the NACAIT is provided for through a Space Station Technical Task Agreement with the MOD at JSC and the ISSPO Operations Office.

6.2.8 Network Support Group

The NSG, led by GSFC, is a consolidation of the requirements-based Network Support Committee (NSC) and the operations-based Network Operations and Integration Group (NOIG) into one entity. The primary goal of the NSG is to provide an integrated approach to highly reliable, top-quality network services to HSF Programs. The NSG provides the forum for a comprehensive review of previous missions, engineering and operational issues, long-term planning policy, and requirements. The NSG is chaired by the GSFC ND and has participation from the ISSP, CRS, the MPCV, and COTS, as necessary. Membership of the NSG is comprised of all network and service providers.

6.2.9 Program Requirements Control Board

The Program Requirements Control Board (PRCB), managed by JSC, is the controlling authority for the ISSP baseline, including all changes to the baseline. Specific items, which shall be dispositioned by the PRCB, include:

a. Budget allocations.

b. Expenditure of funds, which deviate from the POP baseline budget, requiring Allowance for Program Adjustment (APA), or reprogramming.

c. Changes and assessments associated with resolution of major anomalies or incidents, or changes, which are deemed significant to the program.

d. Changes to configuration of accepted/delivered hardware/software.

e. Any change prior to hardware/software acceptance, except mandatory mission reconfiguration or mandatory safety of flight changes.

6.2.10 Security Analysis Response Team

The Security Analysis Response Team (SART), led by JSC, is a multilateral team that coordinates ISS Ground Segment systems security capabilities and processes. The team will provide a forum for resolving technical and schedule issues related to security topics and incidents.

6.2.11 Technical Interchange Meetings

Technical Interchange Meetings (TIM) are held face-to-face or via telecom to exchange technical information related to support of the ISS, MPCV, and COTS as necessary.

Section 7. Requirements Management

7.1 Universal Documentation System

The Universal Documentation System (UDS) has been specified by the JSC-27379, *Support Requirements System Management Plan*, for the formal transmittal and receipt of HSF requirements and plans as shown in Figure 7-1.

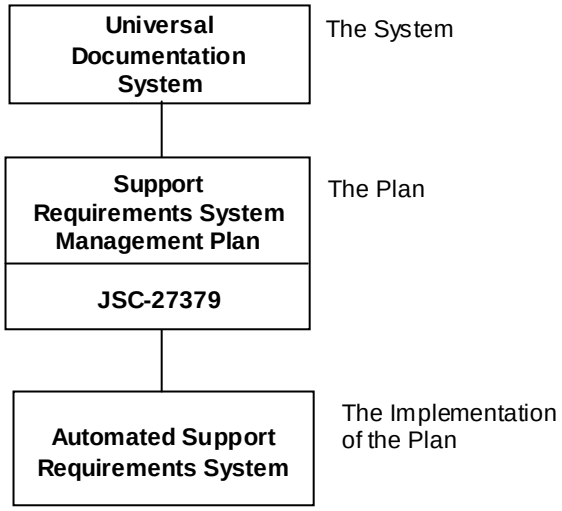


Figure 7-1. Requirements Management Structure Supporting the HSF Program

7.2 Automated Support Requirements System

The Automated Support Requirements System (ASRS) is used to communicate HSF requirements and responses among centers/agencies for ISSP operations. The ASRS incorporates the basic principles, structure, and format of the UDS and employs electronic hardware, supported by software programs, as a technique for processing support requirements information.

7.3 Documentation

7.3.1 General

The UDS recognizes three levels of documentation that are applicable to the HSF Programs. These three levels are described in paragraphs 7.3.2 through 7.3.4 and are illustrated in Figures 7-2 and 7-3. The documentation flow for ISS is shown in Figures 7-4 and 7-5.

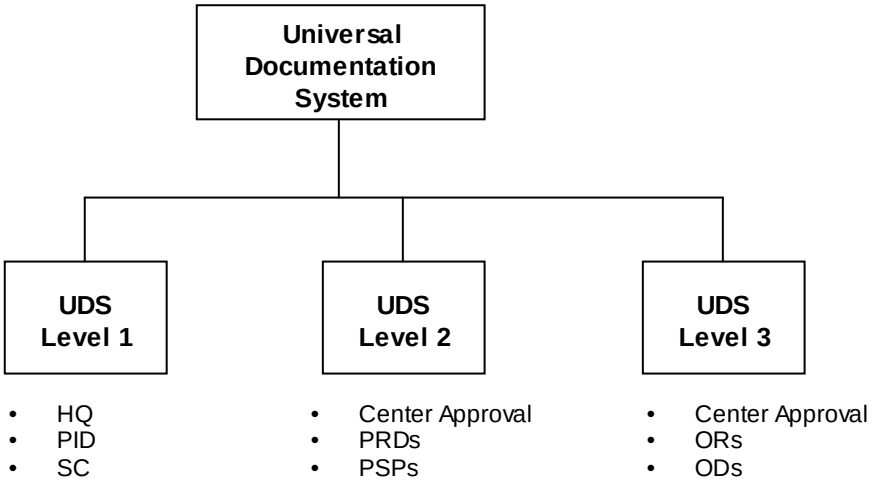


Figure 7-2. Documentation Structure Supporting the HEO

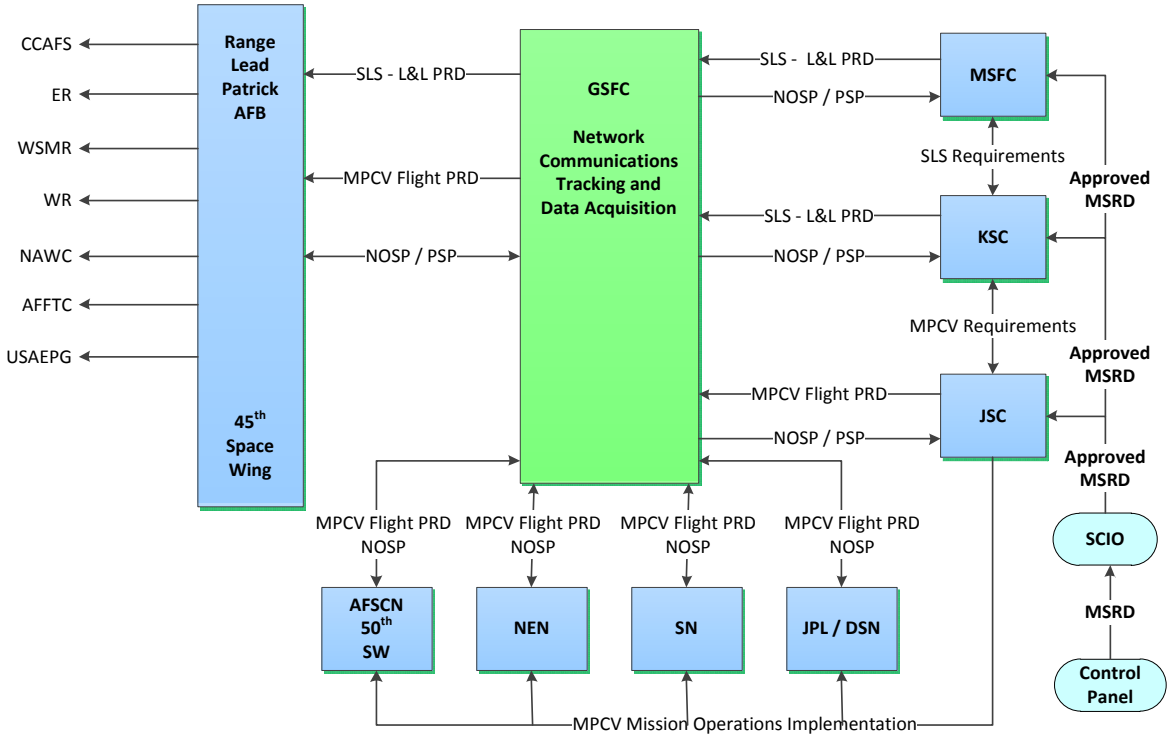


Figure 7-3. Documentation Flow Diagram for the MPCV

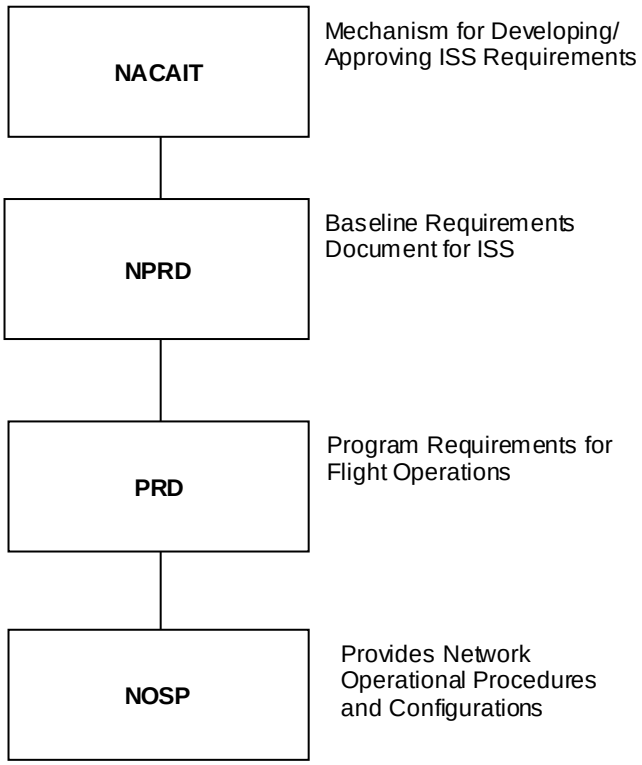


Figure 7-4. Documentation Flow Diagram for ISS

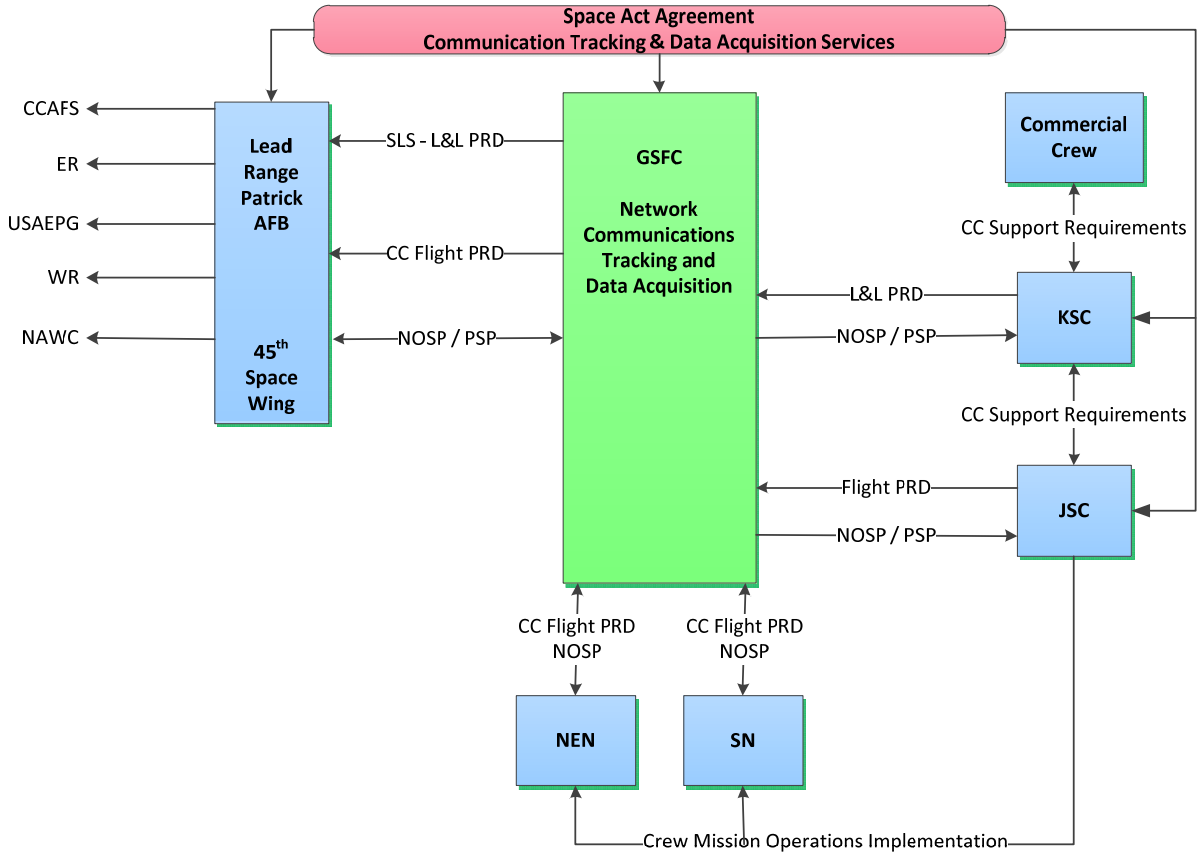


Figure 7-5. Documentation Flow Diagram for Commercial Crew

7.3.2 UDS Level 1

Level 1 documents requiring NASA Headquarters approval include the Program Introduction Document (PID) and the Statement of Capability (SC).

a. PID. The PID is prepared by the Program Office 3 to 4 years before the first flight and contains all generic program requirements that can be identified at that time. The PID is submitted to NASA Headquarters for Program Director approval and acceptance prior to transmittal to support agencies.

b. SC. All support agencies except GSFC and AFSCN prepare a SC specifying the facilities available or needed to support requirements specified in the PID. (The SC is the support agency's response to the PID and provides evidence that the program has been accepted for support.)

c. PRD. Shall satisfy the requirement of the PID.

NOTE

For the ISSP, the SSP 54001, *Network Program Requirements Document (NPRD)*, further defines and integrates the operational requirements of the PID.

7.3.3 UDS Level 2

Level 2 documents require center-level approval and include the PRD and the Program Support Plan (PSP).

a. A set of PRDs consists of the PRD for Launch and Landing (L&L) operations and the PRD for flight operations. These PRDs are divided into three volumes: Volume I contains support requirements and Volume II contains payload support requirements. Volume II, Basic, contains generic cargo requirements; specific payload support requirements are contained in separate annexes to Volume II. Volume III contains ISS pre-launch and Launch requirements. The PRDs and updates are constrained within the scope of the collective requirements stated in the PIDs. Responsibilities for integration of requirements and publication of the two PRD sets are divided between the flight operations agency (JSC), ISS payload agency, and the L&L operations agents (KSC).

b. PSP. Each support agency prepares PSP-type responses to each PRD. GSFC coordinates the PSP with AFSCN and provides a response to the PRD. The PSP commits resources, identifies items that cannot be supported, and identifies charges that must be reimbursed to the support agency for services rendered. JSC receives and evaluates all PSP responses to the flight PRD for Space Station launches; KSC receives and evaluates all PSP responses to the KSC L&L Volume I, II, and III PRDs.

7.3.4 UDS Level 3

Level 3 documents require center-level approval and include the Operations Requirement (OR) and the Operations Directive.

a. Ors are prepared by JSC and KSC as applicable, for each major pre-launch test, for Launch, flight, and post-landing support. The OR contains detailed and specific requirements unique to that mission phase or test, as previously documented in overall program terms in the PRD. Requirements in OR documents cannot exceed the scope of those identified in the PRD.

b. Operations Directives are prepared by the support agencies for directing support agency operations in response to requirements documented in the OR. The operations directive also identifies resources and communication facilities used to support an OR.

7.3.5 Network Program Requirements Document

a. The NPRD has been prepared by the Program Operations Office in accordance with the *Support Requirements Management System*. The NPRD supports the UDS structure and guidelines for the presentation of operational support requirements and will be integrated into the ASRS database maintained by KSC.

b. The NPRD is intended to further define and integrate the operational requirements of the PID SSP 54001. The NPRD contains the ISSP user identified network and communications support requirements initially projected in the PID, further developed.

c. The NPRD will serve as a baseline requirements document detailing all operational communications requirements (data, voice, and video) for the program beginning with First Element Launch (FEL) of the ISSP, including preparations for FEL, and extending through the life of the program.

d. Coordination and review of Network requirements is provided through the NACAIT. This document will be integrated in the NACAIT meetings, and will be submitted to the ISSP for approval and transmitted to the NASA SCIO for implementation approval.

Section 8. Readiness Reviews

8.1 General

The HSF Program holds several readiness reviews prior to each mission, flight and ISS increment, other major events and to certify significant changes for HSF mission operations use. The purpose of these reviews is to assess the readiness of all elements and to produce a CoFR. A tier of downward endorsement requirements and upward certifications are defined for each program or project element defined in the mission objectives, support requirements and verifies the readiness at each level from the bottom up to the HEO Directorate review and certification.

8.2 Operational Readiness Review at GSFC

At approximately Launch minus 30 days, the GSFC conducts the Integrated Network Readiness Review. Section 2 of this document describes the ORR. Risk assessments are made on any open issues, which could affect the mission and Requests for Action (RFA) assigned by the review board to deal with open issues or concerns. The ORR produces the signed Network CoFR.

8.3 JSC/MOD FRR

The JSC/MOD FRR is held at JSC approximately Launch or event minus 30 days and is chaired by the JSC/MOD Lead Flight Director with participation from the flight team and network segments. The purpose of the FRR is to assess the readiness of the Flight Team, the Flight Crew, and the Network to satisfy the requirements of the upcoming mission or event. The ND presents the Integrated Network readiness requirements, readiness endorsement, open work and exceptions, risks, and other significant status items as well as the Network CoFR. The FRR produces the Signed MOD CoFR. The flight director office presents the results of the MOD review to the Program or Project level Review.

8.4 Stage Operations Readiness Review

The Stage Operations Readiness Review (SORR) CoFR, is chartered by the ISSP Mgr., held at JSC, certifies the readiness of the ISSP for Launch, flight, assembly and operations, and includes the Launch package/cargo element, on-orbit stage, ground facilities, and personnel. An ISSP SORR supports and is conducted prior to proceeding with that stage or activity.

8.5 KSC Launch Readiness Review

The KSC Launch Readiness Review (LRR) is chaired by the KSC Center Director and is held at KSC approximately Launch minus 8 days. The LRR has participation from the JSC flight team and GSFC Network representatives. The purpose of the LRR is to assess the Launch Team's readiness to support all Launch-related requirements of the upcoming mission or test flight. This is accomplished by providing the results of testing, simulations, JIS, and Payload (P/L) testing involving the LCC and other ER Launch support facilities. Risk assessments are made on any open issues, which could affect the mission.

8.6 Test Flight Readiness Review

Test Flight Readiness Review (TFRR) is chaired by the Test Flight Project or Program Manager. The HSF Network Director presents the HSF Integrated Network readiness requirements, readiness endorsement, open work and exceptions, risks, and other significant status items based on the results of the ORR as well as the Network CoFR.

8.7 NASA HEO Flight Readiness Review

NASA HQ Associate Administrator for the Human Exploration Operations Directorate chairs this review which includes participation from the Program, Flight Segment, the Launch Segment, and the Network Segment. The purpose of the HEO FRR is to make a final assessment and certification to proceed to Launch.

Abbreviations and Acronyms

Acronym	Definition
21CSLC	21st Century Space Launch Complex, KSC
21CGSP	Figure 2-2
ACA	Associate Contractor Agreements
AEFTP	Ascent/Entry Flight Techniques Panel (JSC/MOD)
AF	Air Force
AFSCN	Air Force Satellite Control Network
A/G	Air-to-Ground
AGMT	Agreement
AI&P	Assembly, Integration and Processing (phase 1 of MPCV mission)
AOS	Advanced Orbiting System
APA	Allowance for Program Adjustment
ARC	Ames Research Center, Moffett Field, CA
ASI	Agenzia Spaziale Italiana (Italian Space Agency)
ASRS	Automated Support Requirements System, (KSC)
ATK	Alliant TechSystems Inc. (Liberty)
ATV	Automated Transfer Vehicle, ISS (ESA)
BCC	Backup Control Center, ISS HOSC, MSFC
BMG	Business Management Group, NISN
BOE	Basis of Estimate, POP
C&DH	Command and Data Handling (equipment)
CAP	Contingency Action Plan
CC	Crew Capsule
CCAFS	Cape Canaveral Air Force Station, FL (ER)
CCB	Configuration Control Board
CCFF	Cape Canaveral Forecast Facility
CCI	Common Carrier Interface

Acronym	Definition
CCP	Commercial Crew Program
CCR	Configuration Change Request
CCT	Figure 2-2
CCSDS	Consultative Committee for Space Data Systems
C&DH	Command and Data Handling
CDR	Critical Design Review
CD&SC	Communications Distribution and Switching Center (KSC)
CDSCC	Canberra Deep Space Communications Complex, Tidbinbilla, Australia, DSN Station;
CEV	Crew Escape Vehicle
CH&SG	Figure 2-3
CIG	Customer Interface Group, CSO/NISN
CIO	Chief Information Officer, MSFC
CM	Crew Module (Orion)
CMD	Command
CMO	Configuration Management Office
CoFR	Certification of Flight Readiness (ORR, FRR, SORR)
COMM Mgr	Communications Manager, NISN
COTS	Commercial Orbital Transportation Services Program
C3PO	Commercial Crew and Cargo Program Office, JSC
CRS	Cargo Resupply Services
CSA	Canadian Space Agency
CSM	Crew Service Module, (EFT-1)
CSO	Communications Service Office
CSR	Customer Support Representative, NISN
CST	Central Standard Time; Crew Space Transportation, (Boeing)
CTL	Compatibility Test Laboratory (GSFC)
CTS	Colorado Tracking Station, AFSCN RTS; (Commercial) Crew Transport System, Blue Origin
CTV	Crew Transfer Vehicle; Compatibility Test Van, (GSFC)

Acronym	Definition
CWG	Communications Working Group
DCN	Documentation Change Notice
DFRC	Dryden Flight Research Center, Edwards AFB, CA
DGS	Diego Garcia Station, AFSCN RTS
DOC	Delta Operations Center (Delta Launch Vehicle/EFT-1)
DoD	Department of Defense
DPRD	Draft Program Requirements Document
DSM	Data Service Manager
DSMC	Data Services Management Center, WSC
DSN	Deep Space Network
DSN-OC	Deep Space Network Operations Center, JPL, Pasadena, CA
EAFB	Edwards Air Force Base, California
E-COMM	Early Communications
EDLH	Engineering Development Houston Laboratory
EFT	Exploration Flight Test (Orion)
EHS	Enhanced HOSC System
ELV	Expendable Launch Vehicle
EMCS	Enhanced Mission Communications System, (MSFC/POIC)
ER	Eastern Range
ESA	European Space Agency
ESC	NASA GSFC Exploration and Space Communications Projects Division, GSFC
ESE	Enterprise Service Executive, CSO
ES&I	Enterprise Services and Integration (DIV,CIO)
ESMC	Eastern Space and Missile Center
ESTL	Electronic Systems Test Laboratory, JSC
ETE	End-to-End
EVA	Extra Vehicular Activity
FAR	Final Acceptance Review

Acronym	Definition
FCR	Flight Control Room, JSC
FCT	Flight Control Team, JSC
FD	Flight Director
FDF	Flight Dynamics Facility, GSFC
FDOC	Facility Development and Operations Contract, JSC
FEL	First Element Launch (ISSP)
FER	Freeze Exemption Requests (GSFC)
FM	Frequency Modulation
FOP	Flight Operations Panel, MPCV
FOV1	Flight Operations Version One, MOC/ROCC
FRR	Flight Readiness Review, JSC-MOD
FTIM	Flight Test Integration Manager (Orion / MPCV)
FTMO	Flight Test Management Office (Orion / MPCV)
FTP	Flight Techniques Panel
GC	Ground Controller (JSC MCC)
GDIS	Guam Data Interface System
GFE	Government-Furnished Equipment
GN	Ground Network (replaced by NEN)
GOP	Ground Operations Panel, MPCV
GRC	Glenn Research Center, Lewis Field, Cleveland, OH
GRGT	Guam Remote Ground Terminal, SN Station
GSCB	Ground Segment Control Board, JSC
GSFC	Goddard Space Flight Center, Greenbelt, MD
GSOC	German Space Operations Center
GSRT	Ground Support Requirement Team, MSFC
GTS	Guam Tracking Station, AFSCN RTS
HDBK	Handbook
HEO	Human Exploration Operations (Directorate)
HOSC	Huntsville Operations Support Center, MSFC

Acronym	Definition
HOTH	Houston Orion Test Hardware
HQ	Headquarters
HSF	Human Space Flight
HSF CWG	Human Space Flight Communications Working Group
HSFN	Human Space Flight Network
HTS	Hawaii Tracking Station, AFSCN RTS
HTV	H-II Transfer Vehicle, ISS (Japan)
HvoDS	HOSC Voice Distribution System
ICD	Interface Control Document
IIGoR	ISS IP Ground Routed Network
IIRV	Improved Interrange Vectors
INP	Internet Predicts
IONet	Internet Protocol Operational Network
ITAR	International Traffic in Arms Regulation
IP	Internet Protocol; International Partner
IPT	Integrated Product Team, ISSPO
ISS	International Space Station
ISSP	International Space Station Program
ISSPO	ISSP Office
IT	Information Technology
ITAR	International Traffic in Arms Regulation
I3P	Information Technology(IT) Infrastructure Integration Program
JAXA	Japan Aerospace Exploration Agency
JDMTA	Jonathan Dickinson Missile Tracking Annex
JIS	Joint Integrated Simulations
JOP	Joint Operations Panel
JPL	Jet Propulsion Laboratory, Pasadena, CA
JSC	Johnson Space Center, Houston, TX
KMR	Air Force Radar

Acronym	Definition
KSA	K-band Single Access
KSC	Kennedy Space Center, FL
KTS	Kennedy Tracking Station,
LAN	Local Area Network
LAS	Launch Abort System
L&L	Launch and Landing
LCC	Launch Control Center, KSC
LEO	Low Earth Orbit
LLTDS	Launch and Landing Tracking Data System, CCAFS
LM	Lockheed Martin
LRC	Langley Research Center, Hampton,VA
LRP	Landing Recovery Panel, MPCV
LRR	Launch Readiness Review (KSC)
LV	Launch Vehicle
LVDC	Launch Vehicle Data Center , ER Hanger AE
MA	Multiple Access, S-band
MAF, R	Multiple Access Forward, Return
Marshall Ops	Marshall Operations Controller
MCC	Mission Control Center, JSC
MCC-H	Mission Control Center-Houston (for ISS)
MCC-M	Mission Control Center –Moscow (for ISS)
MCM	Mission Commitment Manager (NASA HQ); Mission Commitment Manager, (GSFC/CSO)
MCWG	Mission Communications Working Group (GSFC)
MDM	Multiplexer/Demultiplexer
MER	Mission Evaluation Room, JSC
MIDDS	Meteorological Interactive Data Display System, CCFF
MOA	Memorandum of Agreement
MOC	Mission Operations Center, JSC; Morrell Operations Center, ER

Acronym	Definition
MOD	Mission Operations Directorate, Code DA, JSC
MOMS	Mission Operations and Mission Services (contract)
MON	Mission Outage Notification
MORR	Mission Operations Readiness Review
MPCV	Multi-purpose Crew Vehicle
MPS	Main Propulsion Systems, SLS; Mission PC Services
MSFC	Marshall Space Flight Center, Huntsville, AL
MSOC	Mission Support Operations Contract
MSRD	Mission Support Requirements Document
NACAIT	Network and Communications Analysis and Integration Team, JSC
NACB	Network Access Control Board
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications, GSFC
NAWC	Naval Air Warfare Center
NBL	Neutral Buoyancy Laboratory
NCCDS	Network Control Center Data System, WSC
ND	Network Director, GSFC
NEN	Near Earth Network (formerly GN)
NENS	Near Earth Networks Services (contract)
NGIN	Next Generation Integrated Network (GSFC on-line library)
NHS	New Hampshire Station, AFSCN RTS
NIC	Network Integration Center, GSFC
NICS	NASA Integrated Communications Services
NIMO	Networks Integration Management Office, Code 450.1, GSFC
NISN	NASA Integrated Services Network, CSO
NM	Network Manager
NMC	Network Management Center, Horsham, Pennsylvania (USN Ground Station)
NNSG	NISN Network Scheduling Group

Acronym	Definition
NOD	Network Operations Directive
NOIG	Network Operations and Integration Group (operations)
NOIT	Network Operations and Integration Team
NOSP	Network Operations Support Plan
NPRD	Network Program Requirements Document
NSC	Network Support Committee (requirements)
NSG	Network Support Group
NSM	NICS Service Manager; NISN System Manager
NSR	NASA Integrated Communications Services (NICS) Service Requests
NSTS	National Space Transportation System
OCI	Office of Chief Information Officer
O&C	Operations and Checkout (Facility), KSC
OCIO	Office of the Chief Information Officer
OD	Operational Downlink; Operations Directive
ODAR	Obsolescence Science Driven Avionics Re-Design
OIP	Operations Interface Procedure
Ops	Operations
OR	Operations Requirement
Orbital	Orbital Sciences Corporation
ORD	Operations Requirement Document
ORR	Operations Readiness Review
ORT	Operations Readiness Test
PCC	International Partner Payload Control Center
PDR	Preliminary Design Review
PDSS	Payload Data Services System (MSFC HOSC/POIC)
PID	Program Introduction Document
P/L	Payload
PMM	Permanent Multipurpose Module, ISS
POC	Point of Contact

Acronym	Definition
POCC	Payload Operations Control Center
POIC	Payload Operations Integration Center, MSFC
POP	Program Operating Plan
PPS	Payload Planning System (MSFC/POIC)
PRCB	Program Requirements Control Board, JSC
PRD	Program Requirements Document
PSLA	Programmatic Service Level Agreement
PSP	Program Support Plan
RADAR	Radio Detection And Ranging
RANS	Range Squadron
RCO	Range Control Officer, DFRC/AF
RCP	Right-hand Circular Polarization
RDR	Radar
RF	Radio Frequency
RFA	Request for Action, ORR
RFI	Radio Frequency Interference
RFICD	Radio Frequency Interference Control Document
ROCC	Range Operations Control Center , ER/MOC
RPS	Record and Playback System, KSC
RSA	Russian Space Agency
RSVG	Russian Service Group, CSO
RTS	Remote Tracking Station, AFSCN
SAA	Space Act Agreement, NASA – Commercial
SART	Security Analysis Response Team
SBU	Sensitive But Unclassified
SC	Statement of Capability
ScaN	Space Communications and Navigation (Program)
SCD	Small Conversion Devices
SCIO	Space Communications Integration Office, Code DD13, JSC MOD

Acronym	Definition
SCNS	Space Communications Network Services (contract)
SDIL	Software Development Integration Laboratory
SGLT	Space-to-Ground Link Terminal
SGSS	Space Network (SN) Ground Segment Sustainment
SLC	Space Launch Complex
SLE	Space Link Extension
SLS	Space Launch System
SM	Service Module
SMA	S-band Multiple Access
SMC	Space and Missile Systems Center, Kirtland AFB, NM
SMM	Spaceflight Mission Manager, GSFC
SN	Space Network
SNAS	Space Network Access System
SNC	Sierra Nevada Corporation, Dream Chaser
SNGS	Space Network Ground Segment (legacy)
SNUG	Space Network Users Guide
SOC	Simulation Operations Center, GSFC
SOCRRATES	Software Only CEV Risk Reduction Analysis and Test Engineering Simulation
SOM	Service Office Manger, JSC/CSO
SOP	Standard Operating Procedures
SORR	Stage Operations Readiness Review, ISSP
SpaceX	Space Exploration Technologies (Dragon)
SPIP	Station Program Implementation Plan
SRS	Support Requirements System
SSA	S-band Single Access
SSC	Figure 2-3
SSCC	Space Station Control Center
SSIPC	Space Station Integration and Promotion Center (JAXA)

Acronym	Definition
SSPF	Space Station Processing Facility, KSC
STGT	Second TDRSS Ground Terminal, WSC
STS	Space Transportation System
SV	Space Vehicle (Blue Origin)
SW	Space Wing, Air Force
TARS	Test Analysis Retrieval System
TBD	To be determined
TBS	To be supplied
TCP/IP	Transmission Control Protocol/Internet Protocol
TCS	Telemetry and Control Station, Oakhanger, AFSCN RTS
T&DA	Tracking and Data Acquisition
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TDE, S, W	TDRS East, Spare, West
TDZ	TDRS Zoe
TFRR	Test Flight Readiness Review
TIM	Technical Interface; Technical Interchange Meeting
TLE	Two-Line Element
TLM	Telemetry
TNOSP	TDRSS Network Operations Support Plan
TOPO	Trajectory Operations Officer, JSC MCC
TRK	Tracking
TSC	Tele-Science Support Center
TT&C	Tracking, Telemetry, and Command
TV	Television
UDP/IP	User Datagram Protocol/Internet Protocol
UDS	Universal Documentation System
UG	Users Guide
UHF	Ultra High Frequency

Acronym	Definition
UNITeS	Unified NASA Information Technology Services, MSFC
UPS	User Planning System
U.S.	United States
USA	USA Research Park, Huntsville, AL
USAF WG	United Stated Air Force Working Group
USN	Universal Space Network
USOC	United States Operations Center (MSFC/HOSC)
USOS	United States On-orbit Segment, ISS
VAFB	Vandenberg Air Force Base, CA
VDS	Voice Distribution System (local connectivity), GSFC
VHF	Very High Frequency
VSS	Voice Switching System (long line), from GSFC
VTO	Voice Technical Operations
VTS	Vandenberg Tracking Station, AFSCN RTS
VV	Visiting Vehicle (ISS)
VVO	Visiting Vehicle Officer, JSC MCC
WAN	Wide Area Network
WFF	Wallops Flight Facility, Wallops Island, VA, (Launch & Range Facilities)
WG	Working Group
WGS	Wallops Ground Station, Wallops VA
WR	Western Range
WSC	White Sands Complex, NM, (SN station)
WSGT	White Sands Ground Terminal
WSSH	White Sands Space Harbor, NM
ZOE	Zone of Exclusion
45 SW	45th Space Wing

Documentation Change Request

Document Number: _____
Version (Including DCNs): _____
Issue Date: _____

Use this sheet (and attachments if needed) to indicate changes or corrections which will update or improve documents. When completed, send the sheet to:

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Attention: James A. Bangerter
NASA Network Director

Code 450.1 / Bldg 12 / Rm N-131
James.A.Bangerter@nasa.gov

cc: Earl H. Daniel

HSF Documentation Manager
SCNS / TSD / OSC
7855 Walker Drive / Rm 4430
Greenbelt, MD 20770-3212

Earl.Daniel.contractor@exelisinc.com

Example

Suggested Change: _____

Reason for Change: _____

Refer to: (EC, ISI, etc.) _____

Originator's Name: _____ Date: _____

Title: _____

Organization: _____

Location (if APO or P.O. Box): _____

Address: _____

_____

Phone: _____

Fax: _____

For electronic copies of form go to: http://scp.gsfc.nasa.gov/hsfnsg/docs-rev1.html

SCNS-NEI-FORM-0001
Original (12/08/2011)

DOCUMENTATION CHANGE REQUEST

Instructions for use:

Document Number: Fill in the control number of the document for which you are suggesting a change from the upper right-hand corner of the title page.

Version (Including DCNs): Fill in the version of the document such as Original or Revision 1 from the title page and list any printed DCN numbers recorded on the change information page and TTY DCNs recorded on the DCN control sheet.

Issue Date: Fill in the effective date from the title page.

Suggested Change: Specify the data that should be replaced and include the data that should replace it, or provide new data that should be added, and suggest where it should be added to the manual. Include page numbers, paragraph numbers, table or figure numbers and titles as applicable.

Reason for change: Explain why the current data in the manual is incorrect, or why the data needs to be updated.

Refer to: (EC, ISI, etc.) If a formal change document exists which provides further evidence your suggested change should be made, such as an EC, ISI, BM, or PRD requirement, please provide a reference to that change.

Originator's Name: Add the name of the individual suggesting the change to the document.

Title: Provide the name of the position held by the individual such as Operations Supervisor at WGS, or SMM at GSFC, etc.

Organization: Specify operational group such as JSC MCC Command Section, or WGS Tracking, etc.

Location/Address: Provide complete mailing address and E-mail address that can be used to contact the individual suggesting the change.

Phone/Fax: Provide current phone number and fax number where originator can be contacted during normal work hours.

Example

SCNS-NEI-FORM-0001
Original (12/08/2011)

450-NOD/HS

Networks Operations Directive for Human Space Flight Network Support

Revision 4