Soyuz-26, Expedition 27
Increment 27
Mission Operations Readiness Review (MORR)

February 09, 2011

BASELINE 02/14/11

Presented to:

NASA/Goddard Space Flight Center

Networks Integration Management Office, Code 450.1

Agenda

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Review Board

- Kenneth E. Lehtonen, Chairperson, GSFC, Code 301, Systems Review Office
- John J. Hudiburg, GSFC, Code 599, 450 Senior Technical Authority
- Scott A. Greatorex, GSFC, Code 450.1, Chief, Networks Integration Management Office
- Rivers C. Lamb, GSFC, Code 595, Navigation and Mission Design Branch
- Bradford Butts, GSFC, Code 761, Systems Management Branch
- Joseph M. Aquino, JSC-DD13, Manager, Space Communications Integration Office
- Gary A. Morse, GSFC, Code 453, Ground Network Project
- Donald W. Shinners, GSFC, Code 452, Space Network Project
- Michael E. Yettaw, DFRC Range Technical Monitor, Western Aeronautical Test Range
- James A. Bangerter, GSFC, Code 450.1, Human Spaceflight Network Director

Review Schedule

- **Goddard Space Flight Center (GSFC) Mission Operations Readiness Review (MORR)** — **02/09/11**
- **Johnson Space Center (JSC) Mission Operations Directorate (MOD) Flight Readiness Review (FRR)** — **02/15/11**
- **NASA Stage Operations Readiness Review (SORR)** — **02/28/11**

Mission Overview

K. Riley/NENS

Mission Profile

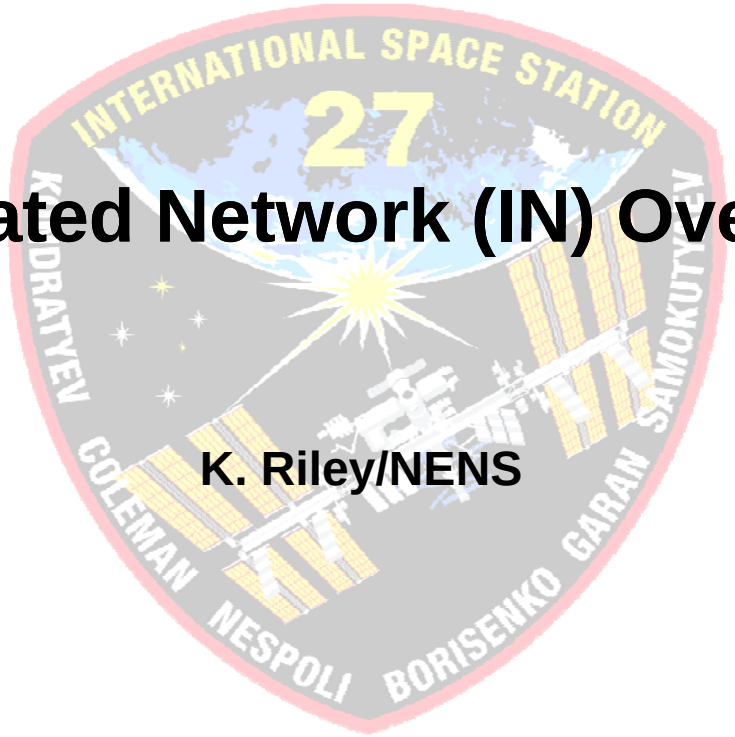
- **Vehicle:** Russian Soyuz
- **Launch Date/Time:** March 30, 2011/0043 GMT
- **International Space Station (ISS) Docking:** April 01, 2011
- **Length of Time Docked:** 6 months (becomes the Russian Crew Return Vehicle)
- **Station Element:** Soyuz
- **Orbit:** 146 nautical miles
- **Inclination:** 51.6 degrees
- **Payload:** Crew, Logistics and Supplies

ISS Supply Sequence

Date	Flight	Launch Vehicle/Elements	
10/07/10	24S Russian Soyuz (Expedition 25)	Crew Transport, Logistics and Re-supply	ISS Increment 25
10/27/10	40P Russian Progress	Logistics and Re-supply	
12/15/10	25S Russian Soyuz (Expedition 26)	Crew Transport, Logistics and Re-supply	ISS Increment 26
01/22/11	HTV-2 Japanese H-II Transfer Vehicle	Logistics and Re-supply	
01/28/11	41P Russian Progress	Logistics and Re-supply	
02/15/11	ATV 2 (Automated Transfer Vehicle) - *Johannes Kepler*	Logistics and Re-supply	
02/24/11	ULF5 Space Shuttle (STS-133)	EXPRESS Logistics Carrier 4 (ELC4), Permanent Multi-Purpose Module (PMM)	
03/30/11	26S Russian Soyuz (Expedition 27)	Crew Transport, Logistics and Re-supply	ISS Increment 27
04/19/11	ULF6 Space Shuttle (STS-134)	Alpha Magnetic Spectrometer (AMS-2), ExPRESS Logistics Carrier (ELC3)	
04/27/11	42P Russian Progress	Logistics and Re-supply	
05/30/11	27S Russian Soyuz (Expedition 28)	Crew Transport, Logistics and Re-supply	ISS Increment 28
06/21/11	43P Russian Progress	Logistics and Re-supply	
06/28/11	ULF7 Space Shuttle (STS-135)	Multi-Purpose Logistics Module (MPLM) Raffaello and a Lightweight Multi-Purpose Carrier (LMC)	

Red Date = Launch Planned

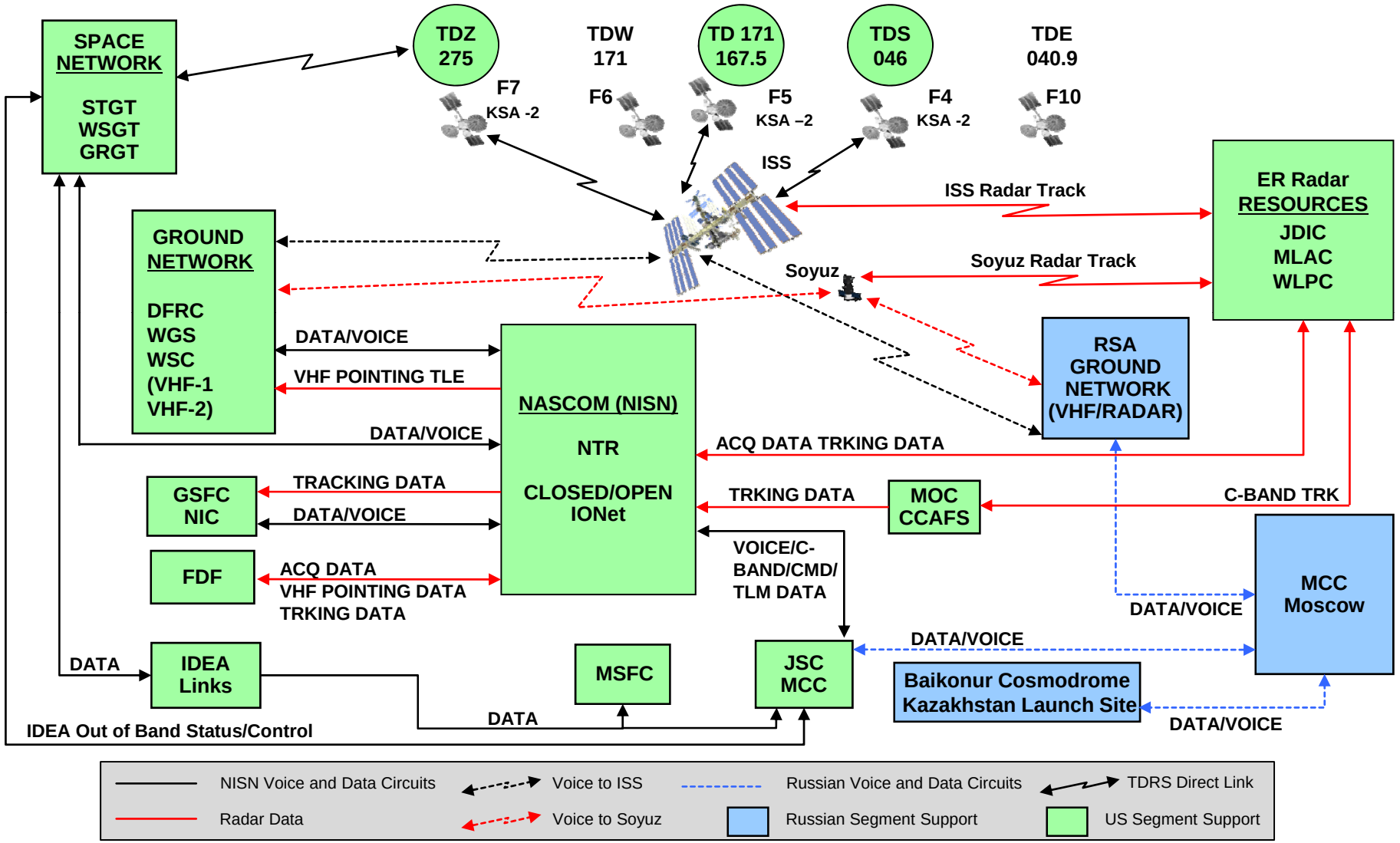
Gray Date = Completed Missions



Integrated Network (IN) Overview

K. Riley/NENS

ISS/Soyuz IN Overview Chart



Documentation

Document Title	Status	Published Date
***TDRSS Network Operations Support Plan for International Space Station*, 450-TNOSP-ISS**	**Original**	**02/2010**
***TDRSS Network Operations Support Plan for International Space Station*, *Very High Frequency Annex*, 450-TNOSP-ISS VHF Annex**	**Original DCN 001**	**09/2006 02/2009**
Interim Support Instruction (ISI) – Pre-mission Status	**In Process**	**Launch minus 30 (02/28/11)**
ISI – Mission Status	**In Process**	**Launch minus 7 (03/22/11)**
ISI – Mission Support	**In Process**	**Launch minus 5 (03/24/11)**
ISI – Mission Configuration Freeze for Soyuz 26 Docking	**In Process**	**Docking minus 7 (03/24/11)**
ISI – Mission Configuration Freeze for Soyuz 24 Undocking	**In Process**	**Undocking minus 7 (03/09/11)**
ISI – Mission Termination (Soyuz 24)	**In Process**	**At conclusion of mission (03/16/11)**
***Configuration Management Freeze Policy for Integrated Networks and Supporting Elements,* 450-CMFP-HSF/ELV**	**Original**	**06/2007**
***NASA Integrated Services Network Standard Operating Procedures*, NISN SOP-0002**	**Revision C**	**11/2007**
Soyuz/Progress/ISS Joint Flight Rules, Vol D, NSTS-12820	**Final PCN-6**	**09/2006 05/2009**

Requirement Changes

- **Program Requirements Document (PRD) changes**
  - **None**

Operational/Network Changes

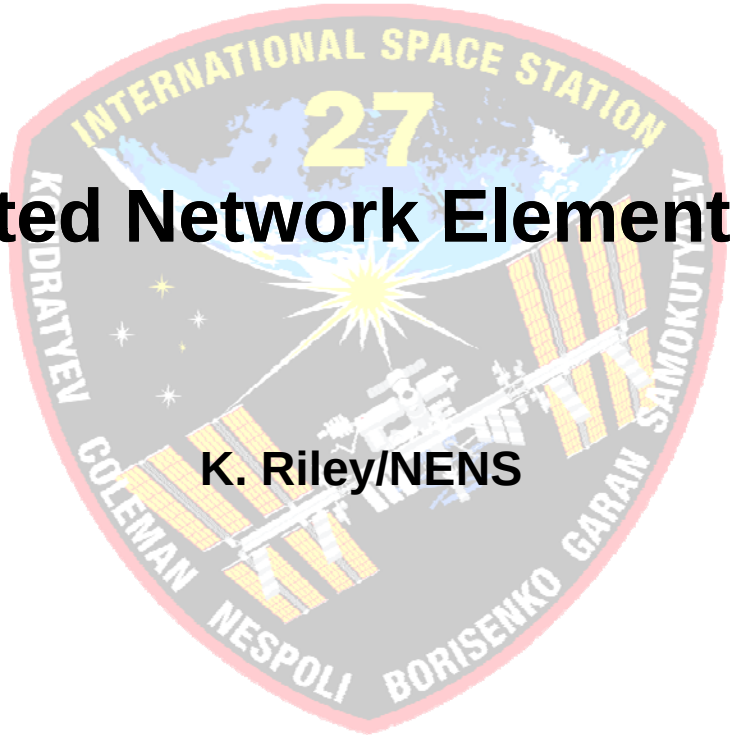
- **Space Communications Network Services (SCNS) Contract Change**
  - **The transition from the Near Earth Network Services (NENS) contract to the SCNS contract will occur on 04/09/11. Entities affected by this transition include:**
    - **GSFC Mission Integration and Operations**
      - **Human Space Flight (HSF) Team (Ground Network Operation Manager's [GNOM], Spaceflight Mission Manager's [SMM], Advanced Mission Planning/ HSF Doc's) / GSFC NIC**
      - **Electronic Systems Test Laboratory (ESTL)**
    - **GSFC Test and Integration**
    - **GSFC Sustaining Engineering**
    - **Wallops Ground Site (WGS)**
    - **White Sands Complex (WSC)**

Operational/Network Changes (cont'd)

- **Very High Frequency (VHF) Recording (WGS and WSC)**
  - **WGS will implement VHF-1/2 transmit and receive recording via the Mission Operations Voice Enhancement (MOVE) system – 02/25/11**
  - **WSC will implement approved EC-TO015-4 VHF-1/2 transmit and receive record capabilities – 03/01/11**

Network Verification Test

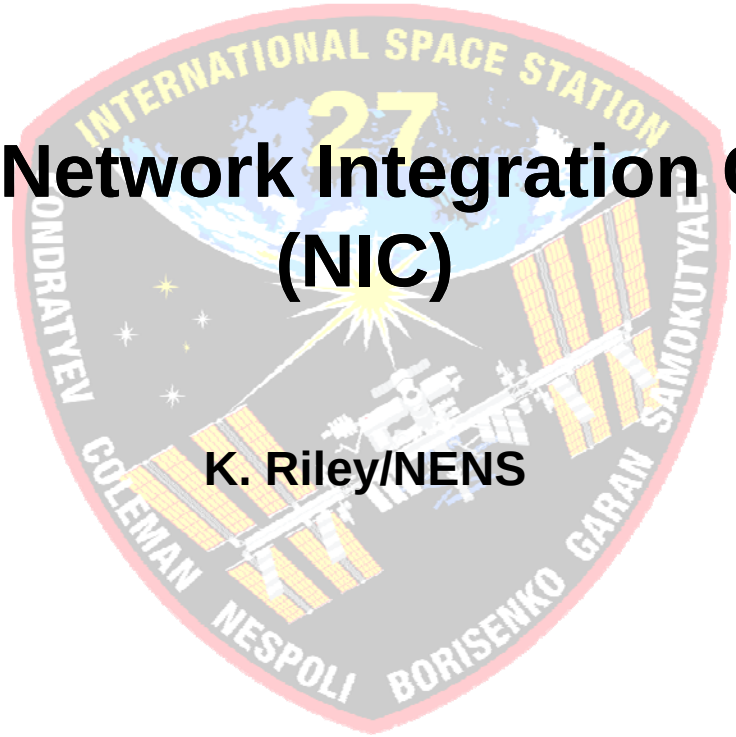
- **VHF Emergency Communication Verification Passes**
  - **VHF-1 two-way voice checks performed with ISS and WGS on 01/10, DFRC on 01/13 & 02/04, and WSC on 01/14 & 02/04***
    - **WSC support was unacceptable due to excessive noise on the system 1 downlink (CDS# 259244)**
      - **Suspect system 1 Power Amplifier (PA)**
      - **New PA ordered**
    - ***WSC VHF antenna stopped tracking during ISS pass on 02/04 due to blown fuse in antenna elevation motor. Suspect extreme cold temperature. Site has exercised antenna on several occasions since 02/04 with no problems. Supports both VHF-1 and VHF-2**
    - **WSC VHF-2 tracking verified by shadowing VHF-1; no active voice communications checks on VHF-2 due to radiation restrictions over the US range**



Integrated Network Element Status

K. Riley/NENS

GSFC Network Integration Center (NIC)



K. Riley/NENS

IN Element Status – NIC

- **Operational Changes since the Soyuz 25 MORR**

Type	System	Significant Changes
Software (S/W)	None	None
Hardware (H/W)	None	None

- **Open Discrepancy Reports (DR)**
  - **None**

IN Element Status – NIC (cont'd)

- **Open Work**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

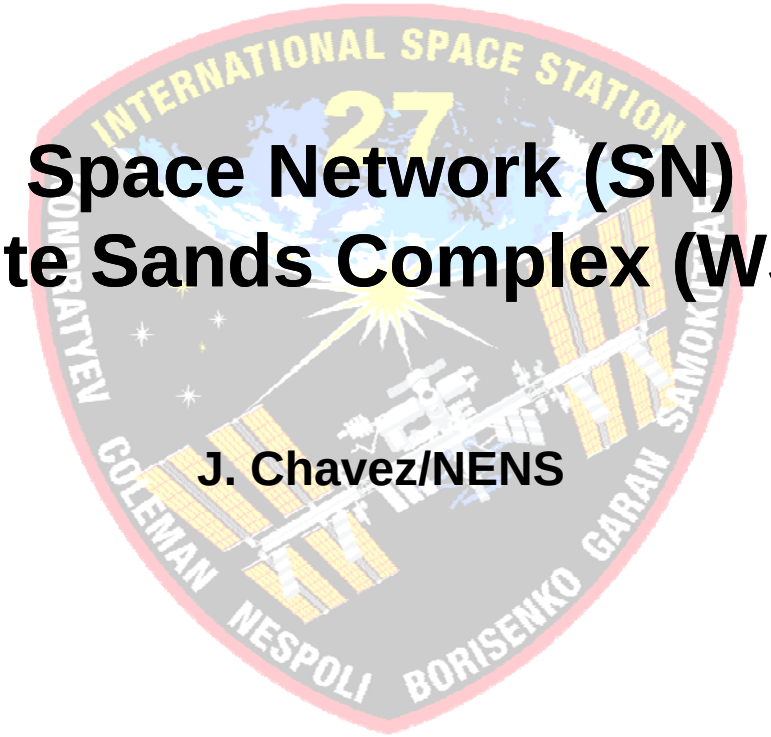
- **Projected Changes**
  - **None**

IN Element Status – NIC (cont'd)

- **NIC Facility Status**

Item	Status	Comments
Commercial Power	G	
Uninterruptible Power Supply (UPS)	G	
Heating, Ventilating and Air Conditioning (HVAC)	G	
Mission Management Area (MMA)	G	

- **Staffing, Training, and Certification**
  - Staffing is sufficient to meet all requirements
- **Documentation Status**
  - Documentation is up to date
- **Summary and Readiness Assessment**
  - NIC is ready to support the Soyuz 26/Expedition 27 and ISS Increment 27



Space Network (SN)
White Sands Complex (WSC)

J. Chavez/NENS

IN Element Status – SN

- **SN Operational Changes since the Soyuz 25 MORR**

Type	System	Significant Changes
Software	S/W delivery 10006	• Maintenance and TDRS-K specific deliveries • Completed 02/16/11
	Space Network Access System (SNAS) release 4	• Transition is planned for – 03/2011 (Post STS-133) • This includes updating the servers at White Sands and the Mission Control Center (MCC) clients
Hardware	MOVE	• Replaces obsolete Multi-Conference Digital Switch (MDS) system at the WSC • Second TDRSS Ground Terminal (STGT) MOVE currently shadowing the Legacy System. Dual operations on 02/18/11 • WSGT and GRGT still on Legacy
	Antenna Sub-System Controller (SSC) Replacement	• Replace obsolete 286 based Central Processing Unit (CPU) chassis with Pentium/ Linux architecture. Replace obsolete Input/Output (I/O) boards • Complete STGT installation 01/2011

IN Element Status – SN (cont'd)

- **Open DRs**
  - **None**
- **Open Work**

Type	System	Significant Changes
Software	None	None
Hardware	Antenna SSC Replacement	White Sands Ground Terminal (WSGT) phase of testing in spare antenna
	MOVE	• WSGT shadowing should start 04/01/11 • Guam Remote Ground Terminal (GRGT) shadowing should start 07/2011

- **Projected Changes**
  - **None**

IN Element Status – SN (cont'd)

- **Tracking and Data Relay Satellite (TDRS) Fleet Management Status**
  - **TDRS-4 (TDS) Power System Degradation**
    - **Battery 1 has failed, and Battery 2 has shown signs of soft short in at least one cell**
    - **Current eclipse season 01/20/11 to 03/23/11**
  - **TDRS-4 (TDS) Telemetry Errors**
    - **TDRS-4 downlink experiencing irregular, apparently random telemetry errors (hits)**
    - **Spare Traveling Wave Tube Amplifier (TWTA) available – corrective action will be performed under GSFC Code 452 direction**

IN Element Status – SN (cont'd)

- **TDRS Fleet Management Status (cont'd)**
  - **TDRS-4 (TDS) Ku-band Single Access (KSA-2) forward power below specification**
    - **The KSA-02 forward service is 5.7 dB below specification for normal power operations and 4.8 dB below specification for high power operations**
    - **A spare TWTA is available for this service**

IN Element Status – SN (cont'd)

- **Staffing, Training and Certification**
  - **Staffing is sufficient to meet all requirements**
- **Documentation Status**
  - **Documentation is up to date**
- **Summary and Readiness Assessment**
  - **SN is ready to support the Soyuz 26/Expedition 27 and ISS Increment 27**

IN Element Status – WSC VHF

- **WSC VHF Operational Changes since the Soyuz 25 MORR**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

- **Open DRs**

Mission Impact (Y/N)	DR#	System/ Subsystem	Problem Description	Operational Workaround	Current Status	Projected Closure Date
Y	258962	VHF-1	Noisy downlink	Operate on System 2 Determined excessive noise with HPA #1	Yellow	05/31/11
Y	259244	VHF-1	Noisy downlink	Operate on System 2	Yellow	05/31/11
Y	259310	VHF-1	Blown fuse in antenna controller	Replace fuse	Yellow	02/28/11

IN Element Status – WSC VHF (cont'd)

- **Open Work**

Type	System	Significant Changes
Software	VHF	Audio record capabilities
Hardware	VHF	Audio record capabilities

- **Projected Changes**
  - **Addition of the transmit and receive audio record capabilities (EC TO015-4)**
  - **Replacement PA**
    - **There will be recertification and operational testing after the system 1 PA is installed before its returned to operational**

IN Element Status – WSC VHF (cont'd)

- **Staffing, Training and Certification**
  - **Staffing is sufficient to meet all requirements**
- **Documentation Status**
  - **Documentation is up to date**
- **Summary and Readiness Assessment**
  - **WSC VHF systems are ready to support the Soyuz 26/Expedition 27 and ISS Increment 27**

Wallops Ground Station (WGS)

M. Harris/NENS

IN Element Status – WGS

- **Operational Changes since the Soyuz 25 MORR**

Type	System	Significant Changes
Software	Transition to upgraded Windows XP version of Wallops Orbital Tracking Resource Scheduler (WOTRS)	• Front/End Database completed 01/18/11 • WOTRS transition completed 01/24/11 • No impact to support expected
Hardware	MOVE	• Addition of the transmit and receive audio record capabilities 02/25/11

- **Open DRs**
  - **None**

IN Element Status – WGS (cont'd)

- **Open Work**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

- **Projected Changes**
  - **None**

IN Element Status – WGS (cont'd)

- **Staffing, Training and Certification**
  - **Staffing is sufficient to meet all requirements**
- **Documentation Status**
  - **Documentation is up to date**
- **Summary and Readiness Assessment**
  - **WGS is ready to support the Soyuz 26/Expedition 27 and ISS Increment 27**

Dryden Flight Research Center (DFRC)

D. Boston/Arcata Associates

IN Element Status – DFRC

- **Operational Changes since the Soyuz 25 MORR**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

- **Open DRs**
  - **None**

IN Element Status – DFRC (cont'd)

- **Open Work**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

- **Projected Changes**
  - **None**

IN Element Status – DFRC (cont'd)

- **Staffing, Training and Certification**
  - **Staffing is sufficient to meet all requirements**
- **Documentation Status**
  - **Documentation is up to date**
- **Summary and Readiness Assessment**
  - **DFRC is ready to support the Soyuz 26/Expedition 27 and ISS Increment 27**

NASA/DoD C-bands Eastern Range (ER)

M. Gawel/ER

IN Element Status – NASA/DoD C-bands

- **Operational Changes since Soyuz 25 MORR**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

- **Open DRs**
  - **None**

IN Element Status – NASA/DoD C-bands
(cont'd)

- **Open Work**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

- **Projected Changes**
  - **None**

IN Element Status – NASA/DoD C-bands
(cont'd)

- **NASA/Department of Defense (DoD) Radars**
  - **The following NASA/DoD Radars will be available:**
    - **Merritt Island 19.14 (MLAC), Jonathan Dickinson 28.14 (JDIC), and Wallops Island Radar 5 (WLPC)**
  - **Plan is to use MLAC, JDIC, and WLPC for Orbit 6**
    - **MLAC, JDIC, and WLPC will track Orbit 6 and provide Low Sample Rate (LSR) data to FDF**

IN Element Status – NASA/DoD C-bands
(cont'd)

- **Staffing, Training and Certification**
  - **Staffing is sufficient to meet all requirements**
- **Documentation Status**
  - **Documentation is up to date**
- **Summary and Readiness Assessment**
  - **ER is ready to support the Soyuz 26/Expedition 27 and ISS Increment 27**

NASA Integrated Services Network (NISN)

A. Duany/UNITeS

IN Element Status – NISN

- **Operational Changes since Soyuz 25 MORR**

Type	System	Significant Changes
Software	None	• None
Hardware	OC-12 upgrades to support HSF requirements in accordance with NISN Support Request (NSR) 34555	• With the carrier's infrastructure upgrade to OC-12's between GSFC/WSC, JSC/WSC, and GSFC/MSFC hardware between these sites has been upgraded to support OC-12's • The OC-12's replace the GSFC/WSC OC-3 (transitioned 01/31/11), JSC/WSC OC-3 (transitioned 01/17/11) and the two DS-3's between GSFC/MSFC (transitioned 12/28/10)

IN Element Status – NISN (cont'd)

- **Marshall Space Flight Center (MSFC)-Russian Services**
  - **The Standard Definition (SD) encoders and decoders in Houston and Moscow have been upgraded with Adtec devices capable of handling High Definition (HD) and SD 11/2010**
  - **During 12/2010 additional bandwidth was partitioned to support the Russian BITS telemetry data stream from Houston to Moscow. BITS telemetry data flow and testing will begin later in this year**
  - **Digital Internet Protocol (IP) based video distribution system has been installed and is running in parallel with analogue video system at MCC-Moscow in 12/2010**
  - **Houston Moscow Mission Services transitioned to Consolidated Mission Services on 10/13/10. All systems have been operating nominal**

IN Element Status – NISN (cont'd)

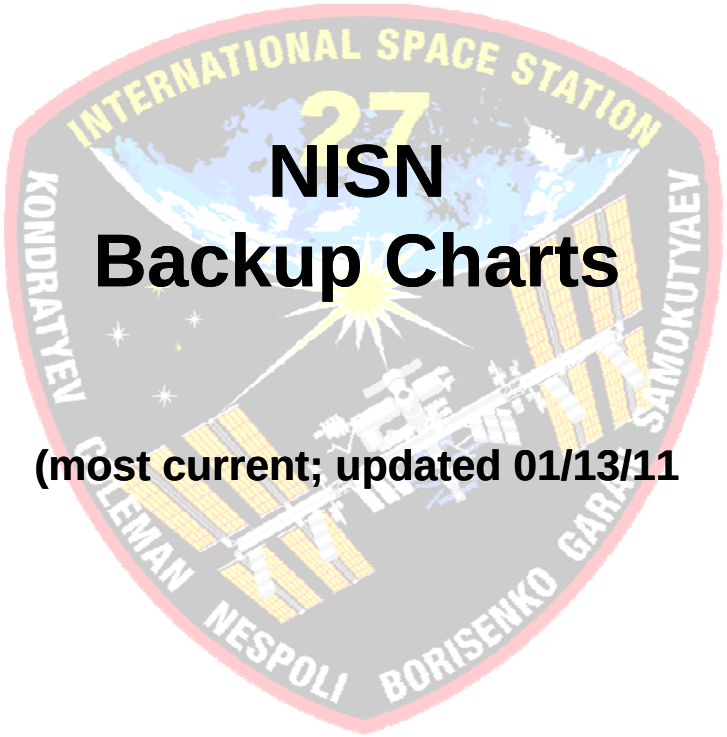
- **Open PMDS Tickets**
  - **None**
- **Open Work**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

- **Projected Changes**
  - **None**

IN Element Status – NISN (cont'd)

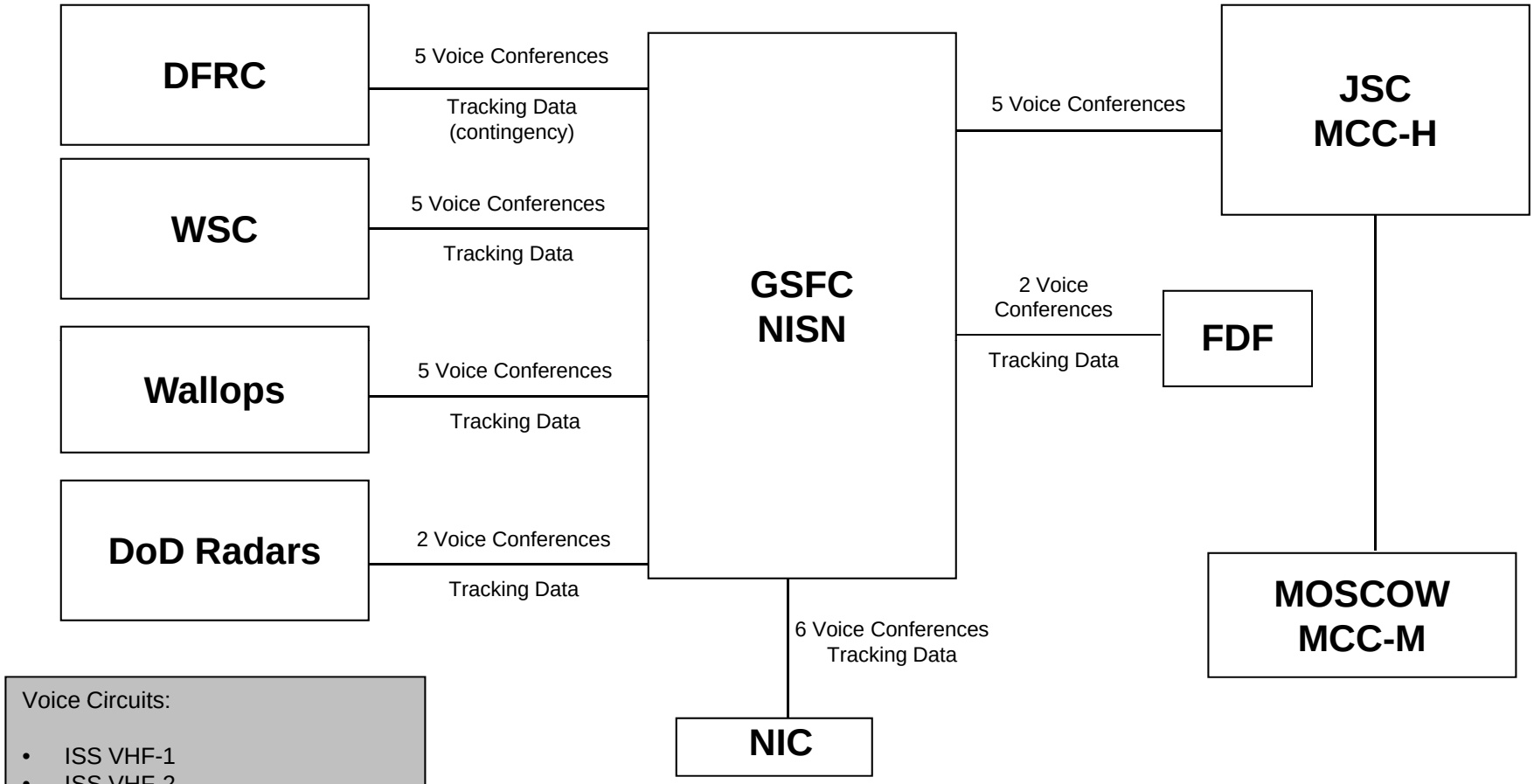
- **Staffing, Training and Certification**
  - **Staffing is sufficient to meet all requirements**
- **Documentation Status**
  - **Documentation is up to date**
- **Summary and Readiness Assessment**
  - **NISN will process all Freeze Exemption Requests (FER) during mission in accordance with NISN SOP-002, published 10/2009**
  - **NISN is ready to support the Soyuz 26/Expedition 27 and ISS Increment 27**



NISN
Backup Charts

(most current; updated 01/13/11

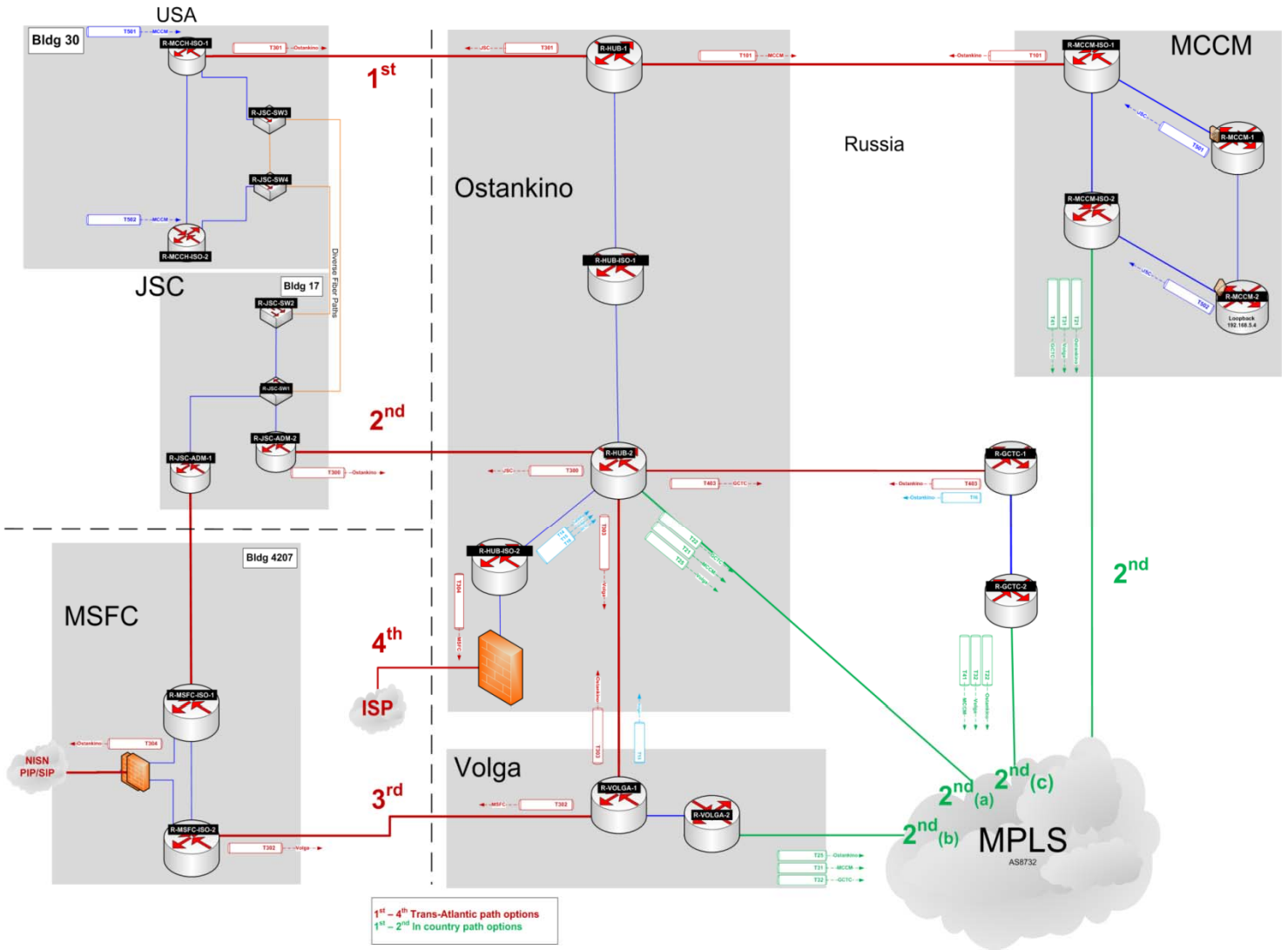
Soyuz Integrated Network Voice and Data Circuits



Voice Circuits:

- ISS VHF-1
- ISS VHF-2
- ISS SITE COORD
- IP/GC-1
- TRACK COORD
- LEAD RANGE COORD

Russian Mission Network Backbone



Flight Dynamics Facility (FDF)

N. Wilcox/FDSS

IN Element Status – FDF

- **Operational Changes since Soyuz 25 MORR**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

- **Open DRs**
  - **None**

IN Element Status – FDF (cont'd)

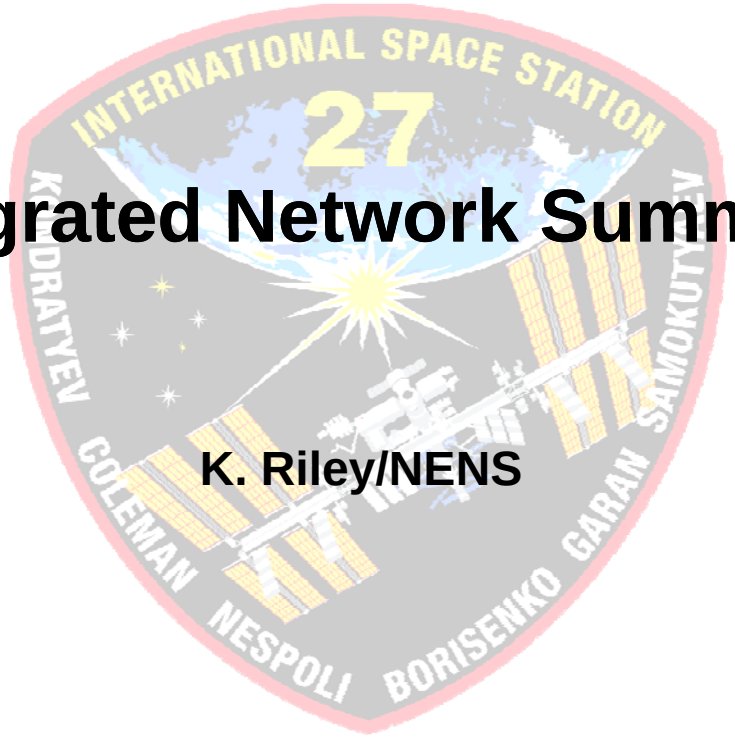
- **Open Work**

Type	System	Significant Changes
Software	None	None
Hardware	Two-Line Elements (TLE)	Verify receipt/processing of Soyuz 26 TLE by VHF sites

- **Projected Changes**
  - **None**

IN Element Status – FDF (cont'd)

- **Staffing, Training and Certification**
  - **Staffing is sufficient to meet all requirements**
- **Documentation Status**
  - **Soyuz 26 Mission Support Plan (MSP) will be delivered by 03/23/10**
- **Summary and Readiness Assessment**
  - **FDF is ready to support the Soyuz 26/Expedition 27 and ISS Increment 27**



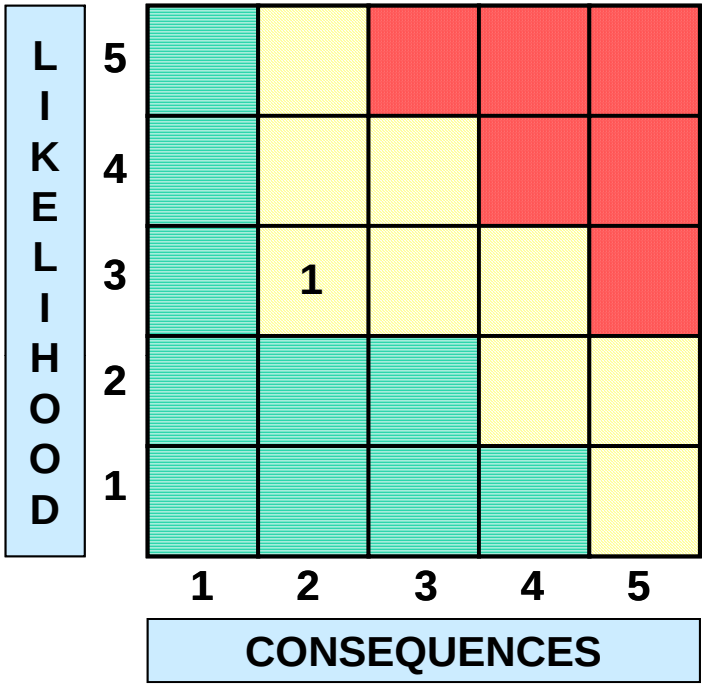
Integrated Network Summary

K. Riley/NENS

Requirements/Test Matrix

Network Resource	Requirement	Verification Method	Verification Complete
Space Network	• ISS S-band Forward/Return • ISS K-band Forward/Return	Operational	Operational
White Sands VHF-1 VHF-2	• Contingency communications support to ISS • Soyuz contingency communications support during selected view periods from early orbit through ISS docking	Emergency Comm Verification Passes (VHF-1)	01/14/11 & 02/04/11
Wallops VHF-1 VHF-2	• Contingency communications support to ISS • Soyuz contingency communications support during selected view periods from early orbit through ISS docking	Emergency Comm Verification Passes (VHF-1)	01/10/11
Dryden VHF-1 VHF-2	• Contingency communications support to ISS • Soyuz contingency communications support during selected view periods from early orbit through ISS docking	Emergency Comm Verification Passes (VHF-1)	01/13/11 & 02/04/11
Eastern Range	• C-band metric data support, tracking of Soyuz for VHF-2, and C-band slaving at DFRC for emergency support only	Operational	Operational
NASA Integrated Services Network	• Voice/Data Communications	Operational	Operational
Flight Dynamics Facility	• Provide Tracking and Data Relay Satellite System (TDRSS) vectors for ISS support • Perform ISS orbit determination for acquisition data and planning products • Provide TLEs for VHF tracking	Operational Operational Simulated Orbital Support	Operational Operational

Risks



LxC Trend	Rank	Approach	Risk Title
➡	1	M	VHF-2

Criticality	L x C Trend	Approach
High	⬇ Decreasing (Improving)	M – Mitigate
Med	⬆ Increasing (Worsening)	W – Watch
Low	➡ Unchanged	A – Accept
	* New since last mission	R – Research

VHF-2 Risk

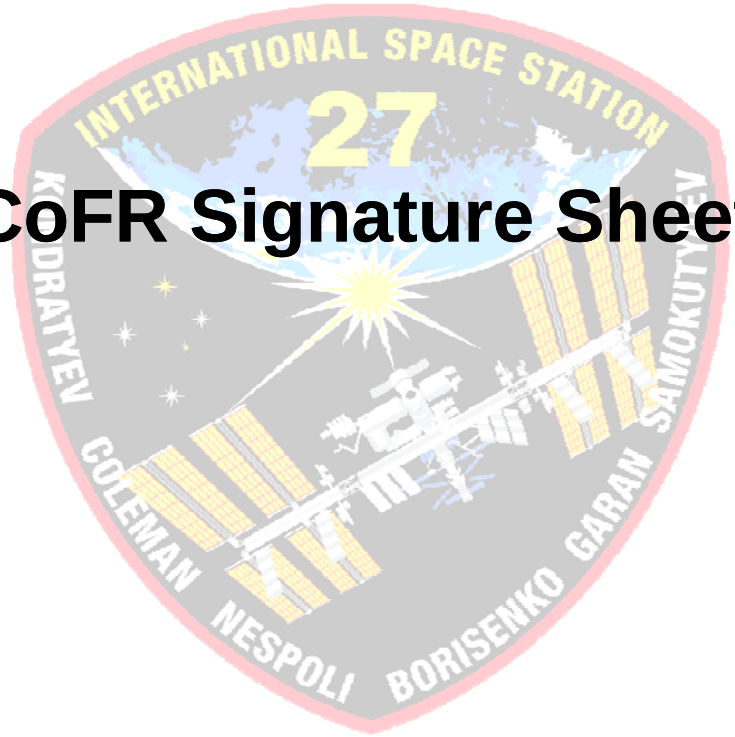
Rank	Risk Statement	Approach & Plan	Comments
1 M	If the VHF-2 system is not periodically End-to-End (ETE) tested including Radio Frequency (RF) transmission, then the system's readiness to support cannot be validated	Mitigate • U.S. Airways is reviewing the request for testing and an approval letter was sent from the airline • Test plan has been completed. Plans are to establish quarterly ETE test • Testing of the VHF-2 emergency voice interfaces via DFRC/WSC/WGS has been placed on hold. The use of the U.S. restricted frequencies is being revisited by JSC Spectrum Management	VHF-2 Systems at DFRC, WSC, and WPS are utilized to support emergency voice communications with Soyuz capsules. CONUS use of the VHF-2 frequency is restricted by FCC, as it is allocated commercially Systems readiness tests are conducted monthly to verify the system, minus the RF transmission, which is restricted VHF-2 would be used in contingency situations on Soyuz; should the Astronauts have to evacuate the ISS to the Soyuz capsule Note: The FAA has refused to allow the use of the restricted frequency for periodic VHF-2 system validation The last VHF-2 ETE Comm check was performed in September 2004

Risk Criticality	H	M	L

Action Item Summary

S. Testoff/PAAC

Readiness Assessment



CoFR Signature Sheet

Exploration and Space Communications Projects Division

Certificate of Flight Projects Directorate Networks Readiness

This is to certify that with successful completion of flight readiness preparations and closure of associated action items, all integrated network elements are ready to support the Soyuz-26, Expedition 27 mission

Kenneth E. Lehtonen, Chairperson, Code 301, GSFC, Systems Review Office — Date

Rivers C. Lamb, Code 595 — 2/9/11 — Date
GSFC, Navigation and Mission Design Branch

for John J. Hudiburg, Code 599 — 2/9/2011 — Date
GSFC, 450 Senior Technical Authority

Gary A. Morse — 02/09/2011 — Date
KSC, Space Communications and Integration

Scott A. Greatorex, Code 450.1 — for 02/09/2011 — Date
GSFC, Chief, Networks Integration Management Office

Joseph M. Aquino, JSC, Code DD13 — 02/09/2011 — Date
Manager
Space Communications Integration Office

Exploration and Space Communications Projects Division

Certificate of Flight Projects Directorate Networks Readiness

This is to certify that with successful completion of flight readiness preparations and closure of associated action items, all integrated network elements are ready to support the Soyuz-26, Expedition 27 mission

Bradford Butts, Code 761
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Abbreviations and Acronyms

Abbreviations and Acronyms

ANTC	Antiqua Island 91.14
CoFR	Certificate of Flight Readiness
CCB	Configuration Control Board
CPU	Central Processor Unit
DoD	Department of Defense
DCN	Document Control Number
DFRC	Dryden Flight Research Center
DR	Discrepancy Report
ER	Eastern Range
ESTL	Electronic Systems Test Laboratory
ETE	End-to-End
FDF	Flight Dynamics Facility
FER	Freeze Exemption Requests
FRR	Flight Readiness Review
GMT	Greenwich Mean Time
GN	Ground Network
GNOM	Ground Network Operation Manager
GRGT	Guam Remote Ground Terminal
GSFC	Goddard Space Flight Center
H/W	Hardware
HD	High Definition
HSF	Human Space Flight
HVAC	Heating, Ventilating and Air Conditioning
IN	Integrated Network
I/O	Input/Output
IP	Internet Protocol
IPE	Internet Protocol Encapsulator
ISI	Interim Support Instruction
ISS	International Space Station
JDIC	Jonathan Dickinson 28.14
JSC	Johnson Space Center
KFRL	Kennedy Forward Return Link
KSA	Ku-band Single Access
KSC	Kennedy Space Center
LOP	Local Operating Procedures
LSR	Low Sample Rate
MCC	Mission Control Center
MDS	Multi-Conference Digital Switch
MILA	Merritt Island Launch Annex
MLAC	Merritt Island 19.17
MMA	Mission Management Area
MOC	Morrell Operations Center (formerly ROCC)
MOD	Mission Operations Directorate
MORR	Mission Operations Readiness Review
MOVE	Mission Operations Voice Enhancement
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications
NENS	Near Earth Networks Services
NIC	Network Integration Center
NISN	NASA Integrated Services Network
NSR	NISN Support Request
PDL	Ponce de Leon
PRD	Program Requirements Document
RF	Radio Frequency
SCNS	Space Communications Network Services
SD	Standard Definition
SGLT	Space-to-Ground Link Terminal
SMM	Spaceflight Mission Manager
SN	Space Network
SNAS	Space Network Access System
SORR	Stage Operations Readiness Review
SSC	Sub-System Controller
STGT	Second TDRSS Ground Terminal
STS	Space Transportation System
S/W	Software
TBD	To Be Determined
TCDT	Terminal Countdown Demonstration Test
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TLE	Two-Line Elements
TOCC	TDRSS Operations Control Center
TRK	Tracking
TT&C	Tracking, Telemetry, and Command

Abbreviations and Acronyms

TWTA	**Traveling Wave Tube Amplifier**
UNITeS	**Unified NASA Information Technology Services**
UPS	**Uninterruptible Power Supply**
VHF	**Very High Frequency**
WLPC	**Wallops Island Radar 5**
WGS	**Wallops Ground Station**
WOTRS	**Wallops Orbital Tracking Resource Scheduler**
WSC	**White Sands Complex**
WSGT	**White Sands Ground Terminal**