Soyuz-31/Expedition 32
Increment 32
Mission Operations Readiness Review (MORR)

May 30, 2012

BASELINE 06/28/12

Presented to:

NASA/Goddard Space Flight Center (GSFC)
Networks Integration Management Office (NIMO), Code 450.1

Agenda

1. **Welcome and Introduction** — **J. Bangerter**
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   - International Space Station (ISS) Supply Sequence
3. **Integrated Network (IN) Overview** — **F. Pifer**
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10. **Abbreviations/Acronyms**

Review Board

- **Carolyn P. Dent, Chairperson, GSFC, Code 301, Systems Review Office**
- **Scott A. Greatorex, GSFC, Code 450.1, Chief, Networks Integration Management Office**
- **Susan L. Hoge, 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**
- **Marco M. Midon, 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)** — **05/30/12**
- **Johnson Space Center (JSC) Mission Operations Directorate (MOD) Flight Readiness Review (FRR)** — **06/06/12**
- **NASA Stage Operations Readiness Review (SORR)** — **06/14/12**

Mission Overview

F. Pifer/Space Communications Network Services (SCNS)

Mission Profile

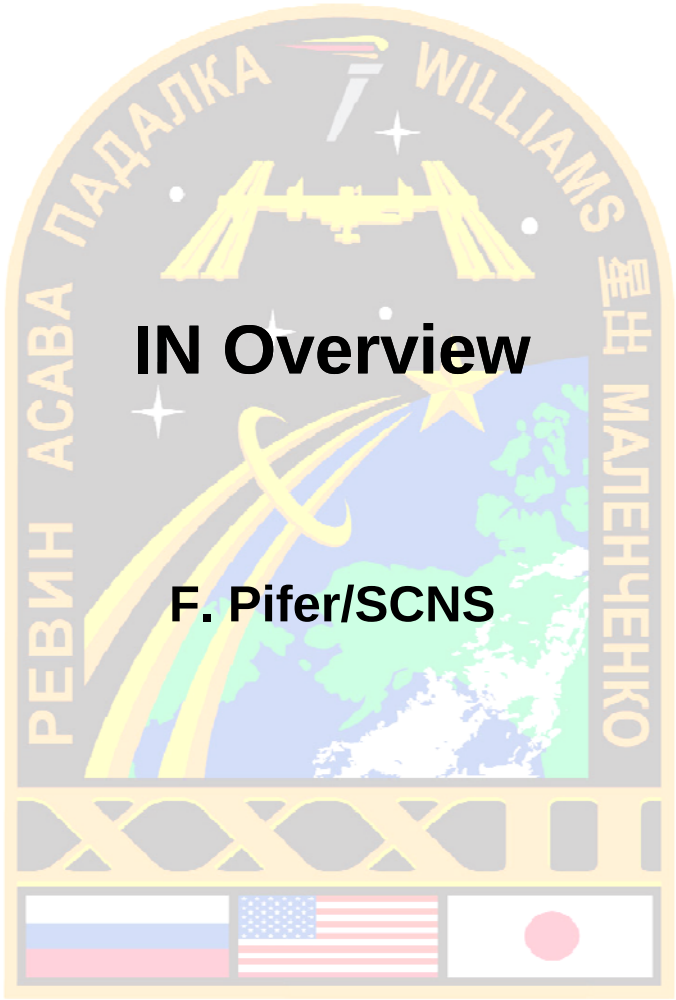
• **Vehicle:**	**Russian Soyuz**
• **Launch Date – Time:**	**07/15/12 – 0237 GMT**
• **ISS Docking:**	**07/17/12**
• **Length of Time Docked:**	**6 months (becomes the Russian Crew Return Vehicle)**
• **Station Element:**	**Soyuz**
• **Orbit:**	**146 nautical miles**
• **Inclination:**	**51.6 degrees**
• **Payload:**	**Crew, Logistics, and Supplies**

ISS Supply Sequence

Date	Flight	Launch Vehicle/Elements	
11/14/11	28S Russian Soyuz (Expedition 29)	Crew Transport, Logistics, and Re-supply	ISS Increment 29
11/22/11	27S Russian Soyuz (Undock)	Un-dock & Return To Earth	
12/21/11	29S Russian Soyuz (Expedition 30)	Crew Transport, Logistics, and Re-supply	ISS Increment 30
01/25/12	46P Russian Progress	Logistics and Re-supply	
03/23/12	ATV 3	Logistics and Re-supply	
04/20/12	47P Russian Progress	Logistics and Re-supply	
05/15/12	30S Russian Soyuz (Expedition 31)	Crew Transport, Logistics, and Re-supply	ISS Increment 31
05/22/12	Falcon 9 Dragon Demo 2	Demonstrate rendezvous and berthing with the International Space Station	
07/15/12	31S Russian Soyuz (Expedition 32)	Crew Transport, Logistics, and Re-supply	ISS Increment 32
07/21/12	HTV 3	Logistics and Re-supply	
07/31/12	48P Russian Progress	Logistics and Re-supply	
09/28/12	Falcon 9 Dragon Demo 3	The first operational cargo delivery mission to the International Space Station	
10/15/12	32S Russian Soyuz (Expedition 33)	Crew Transport, Logistics, and Re-supply	ISS Increment 33
11/01/12	49P Russian Progress	Logistics and Re-supply	
12/12/12	Antares Cygnus 1 Demo 1	Test flight to the International Space Station	

Red Date = Launch Planned

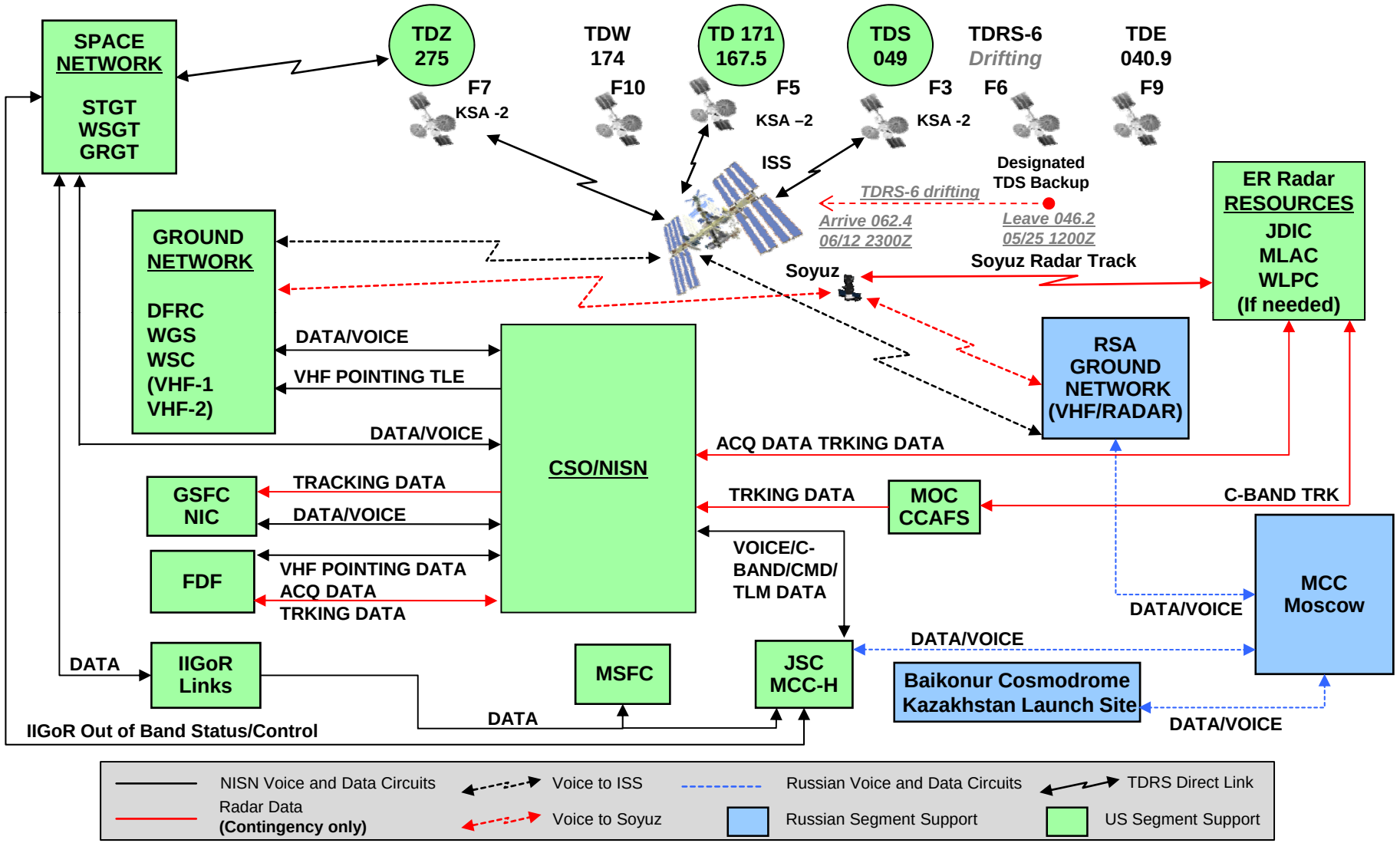
Gray Date = Completed Missions



IN Overview

F. Pifer/SCNS

ISS/Soyuz IN Overview Chart



Documentation

Document Title	Status	Published Date
TDRSS Network Operations Support Plan for the International Space Station, 450-TNOSP-ISS	Original Revision 1	02/2010 01/10/12
ISS Program Requirements Document (PRD)	Volume I	Active Database
Very High Frequency Voice Communications Support Annex to the TDRSS Network Operations Support Plan for International Space Station, 450-TNOSP-ISS, VHF Annex	Original DCN 001	09/2006 02/2009
Interim Support Instruction (ISI) – Change to the GSFC FDF Soyuz Satellite Identification (0516)	Complete	03/08/11
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
ISI – Pre-mission Status	In Process	Launch minus 30 (06/15/12)
ISI – Mission Configuration Freeze for Soyuz 29 Undocking	In Process	Undocking minus 7 (06/20/12)
ISI – Mission Termination (Soyuz 29)	In Process	At conclusion of mission (06/30/12)
ISI – C-band Emergency Call-up Procedure	In Process	Launch minus 10 (07/05/12)
ISI – Mission Status	In Process	Launch minus 7 (07/08/12)
ISI – Mission Support (Soyuz-31 Early Orbit Support)	In Process	Launch minus 5 (07/10/12)
ISI – Mission Configuration Freeze for Soyuz 31 Docking	In Process	Docking minus 7 (07/10/12)

Requirement Changes

- **Program Requirements Document (PRD) changes**
  - **Removal of Shuttle references from the ISS PRD**
  - **ER C-band requirements have been changed to provide contingency only support**
  - **VHF Emergency Communications Update for “Private VHF Communications” is under review**

Operational/Network Changes

- **WSC Upgrades**
  - **VHF-1 Quad Yagi Antenna/Tower installation**
    - **System turned yellow 05/13/12 pending ISS communications checkout**
  - **VHF-1 license renewed on 05/17/12**

Operational/Network Changes (cont'd)

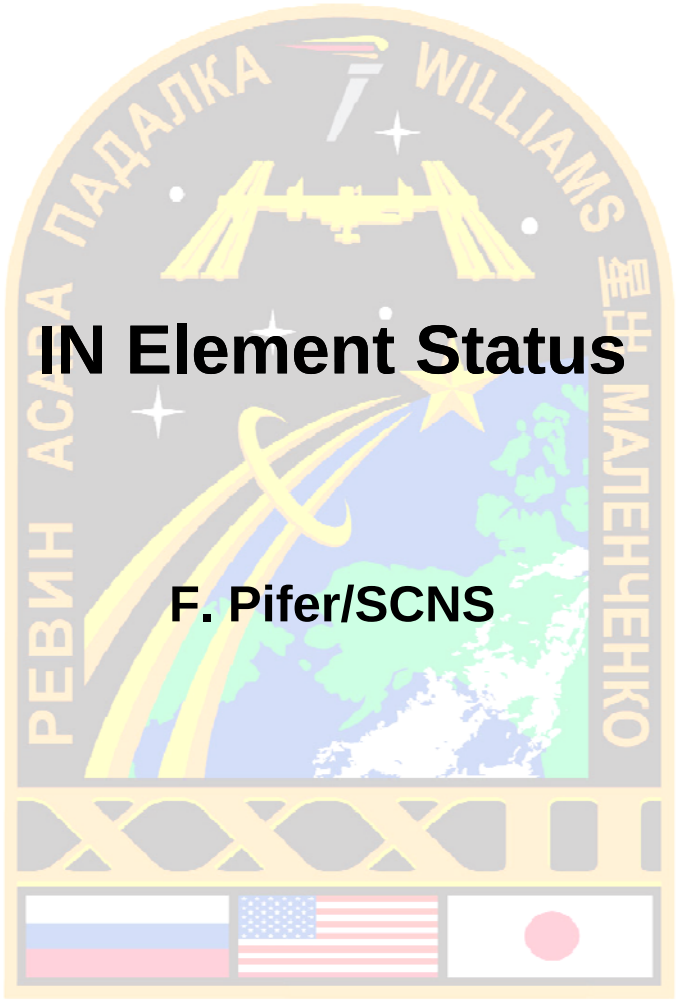
- **WSC Upgrades (cont'd)**
  - **Private Air to Ground (A/G) support via WSC**
    - **Requires no monitoring or recording of A/G voice at all VHF stations**
    - **CSO/NISN procedure in place for new interface with Mission Operations Voice Enhancement (MOVE) system at WSC**
      - **Inhibits recording MOVE digital voice channels**
  - **The WSC VHF Operational Readiness Review (ORR) date is 05/30/12**

Network Verification Test

- **VHF Emergency Communication Verification Passes**
  - **VHF-1 two-way voice checks performed with ISS; good quality with no issues reported**
    - **WGS on 12/26/11; DFRC on 02/23/12**
    - **Future checks planned once per quarter due to busy ISS crew schedule**

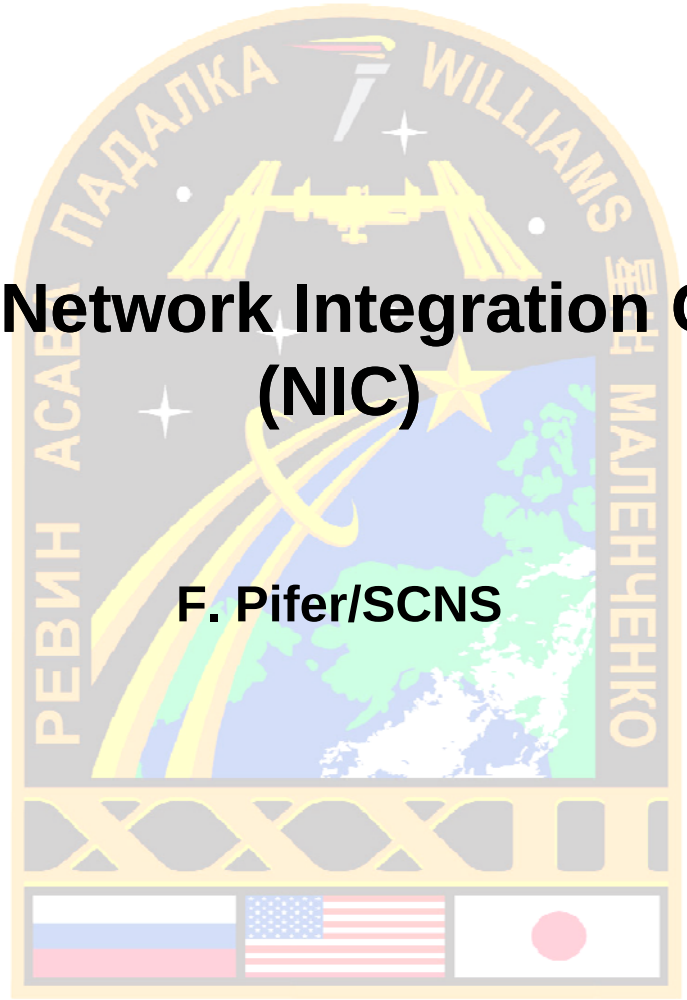
Network VHF Proficiency Simulations

- **Simulations scheduled to ensure proficiency and provide training**
  - **Completed with DFRC & WGS 05/01/12**
    - **Exercised pre-pass and post-pass interface procedures**
    - **Supported by Houston Communications Technician (HCT), GSFC SMM, DFRC, and WGS VHF personnel**
    - **No uplinks permitted; no ISS crew participation**
    - **Tone checks performed**
      - **Stations to JSC and MCC-H/MCC-M**
    - **Stations submitted Pass Summary Reports**
  - **Future VHF Proficiency Simulations planned with all stations**



IN Element Status

F. Pifer/SCNS



GSFC Network Integration Center (NIC)

F. Pifer/SCNS

IN Element Status – NIC

- **Operational Changes since the Soyuz 30 MORR**

Type	System	Significant Changes
Software	None	• None
Hardware	NIC console equipment	• Console equipment is being relocated within the NIC to accommodate the NIC reconfiguration effort • No hardware changes are being done • Reconfiguration effort includes equipment movement and the installation of applicable cabling • All systems will be tested prior to any Network Freeze to ensure reliability

- **Open Discrepancy Reports (DR): None**
- **Freeze Exemption Requests (FER):**

Item	Status	Comments
GSFC Steam Restoration Project	Approved	Excavation, removal and replacement of site steam and condensate distribution pipe between STMH 1 in front of Building 11 to STMH 4 in front of Building 6, generally parallel to and Southwest of Explorer Road
Note : Any FER's that are issued following this MORR will be submitted to the Network Director (ND) for review and approval		

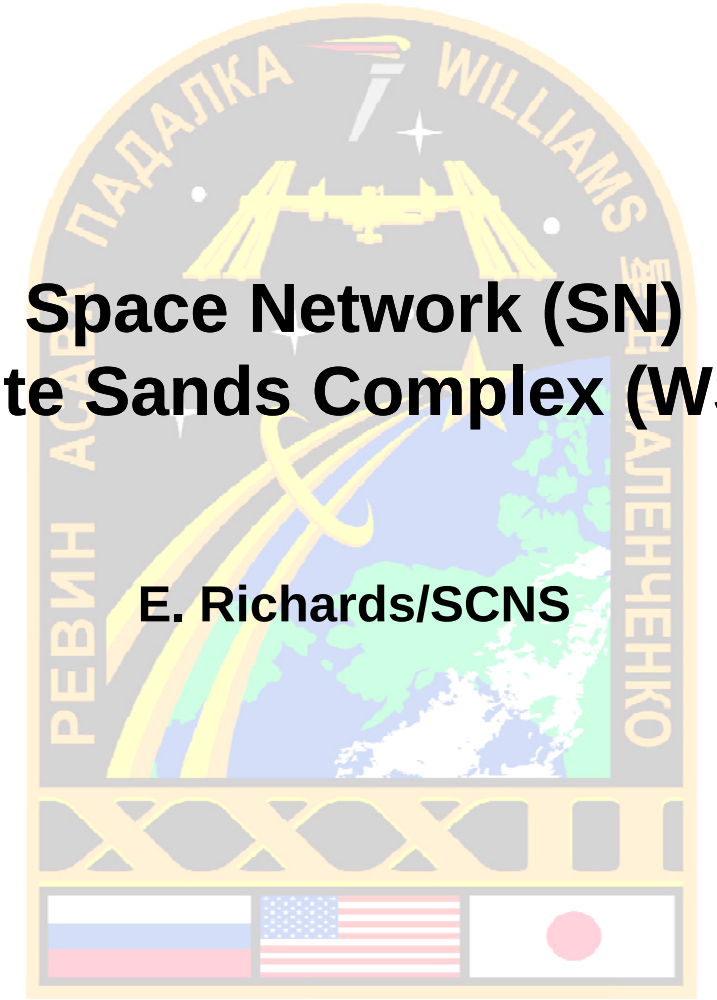
IN Element Status – NIC (cont'd)

- **Open Work: None**
- **Projected Changes:**
  - **NIC consoles/workstations and key set layout reconfiguration in progress**
- **NIC Facility Status:**

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

IN Element Status – NIC (cont'd)

- **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 31/Expedition 32 and ISS Increment 32**



Space Network (SN)
White Sands Complex (WSC)

E. Richards/SCNS

IN Element Status – SN

- **SN Operational Changes since the Soyuz 30 MORR**

Type	System	Significant Changes
Software	Data Interface System (DIS)	• MSA1000 (Firmware delivery to DIS disk drives): Second TDRSS Ground Terminal (STGT) 02/21/12, completed White Sands Ground Terminal (WSGT) 04/04/12
	DIS	• RD422RPL (RS422 Replacement): WSGT 02/28/12 and STGT 03/07/12
	Network Control Center Data System (NCCDS)	• FDF001 (FDF Modernization): 02/29/12
	DIS, User Subsystem (USS), Exec, Tracking Telemetry and Control (TT&C)	• Ops-003/Ports-001: 05/15/12 STGT, 05/23/12 WSGT
Hardware	GRGT Shuttle Unique Equipment (SUE)	• Equipment was shipped to WSC 04/30/12
	MOVE	• WSC has 261 keysets, as of 05/14/12 155 keysets have been retrofitted

- **Open DRs: None**
- **Open Work: None**
- **Projected Changes: None**

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 31/Expedition 32 and ISS Increment 32**

IN Element Status – WSC VHF

- **WSC VHF Operational Changes since the Soyuz 30 MORR**

Type	System	Significant Changes
Software	None	None
Hardware	VHF	VHF-1 and VHF-2 system separation

- **Open DRs:**

Mission Impact Y/N	DR#	System/ Subsystem	Problem Description	Operational Workaround	Current Status	Projected Closure Date
N	260573	VHF-1	Low Power from High Power Amplifier (HPA) #2	Prime HPA is nominal	Yellow	06/2012

IN Element Status – WSC VHF (cont'd)

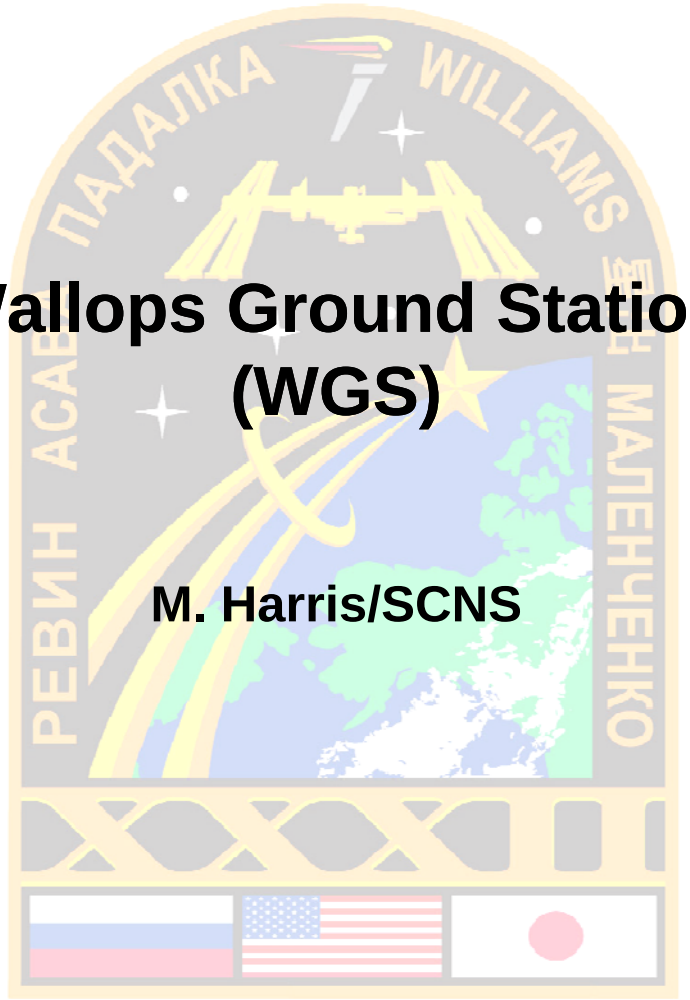
- **Open Work**

Type	System	Significant Changes
Software	None	None
Hardware	VHF-1 and -2	Camera installation

- **EC TO011-01 and -02 have been created for the WSC work**
  - **New VHF-1 tower completed at WSC on 01/15/12**
  - **VHF-1 system move to ETGT started on 01/31/12 with testing completed on 02/22/12**
  - **Camera installation is TBD pending EC approval**
- **VHF-1 status changed to Yellow on 05/13/12 following successful tone checks with Houston**
  - **Will be changed to Green following successful pass with ISS**

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 is ready to support the Soyuz 31/Expedition 32 and ISS Increment 32**



Wallops Ground Station (WGS)

M. Harris/SCNS

IN Element Status – WGS

- **Operational Changes since the Soyuz 30 MORR**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

- **Open DRs: None**
- **Open Work: 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 31/Expedition 32 and ISS Increment 32**

Dryden Flight Research Center (DFRC)

J. Thomas/Arcata Associates

IN Element Status – DFRC

- **Operational Changes since the Soyuz 30 MORR**

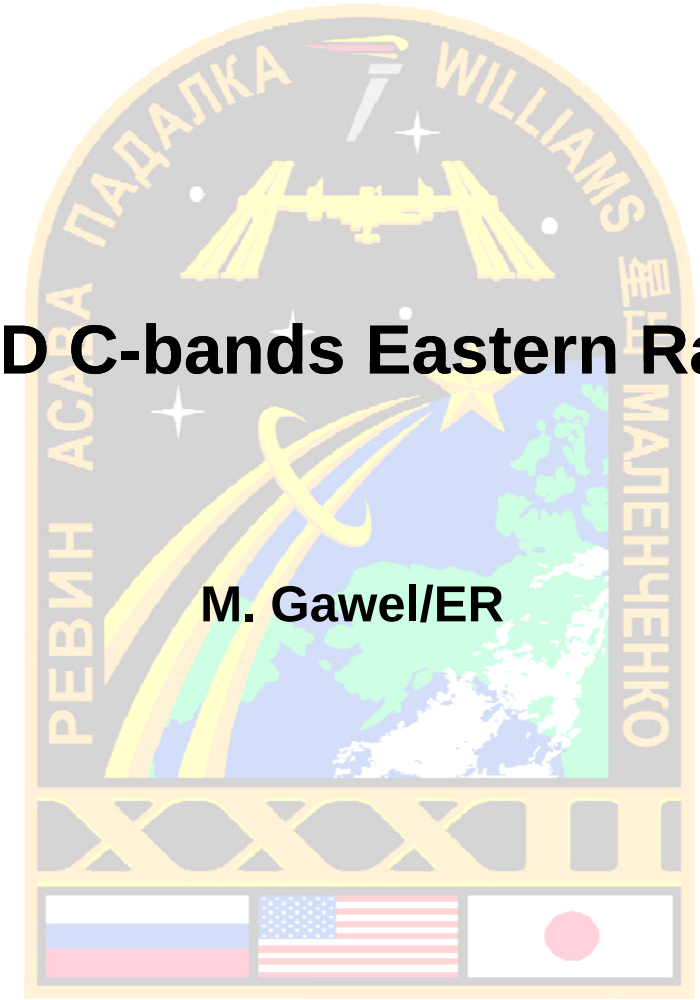
Type	System	Significant Changes
Software	None	None
Hardware	None	None

- **Open DRs: None**
- **Open Work: 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 31/Expedition 32 and ISS Increment 32**

NASA/DoD C-bands Eastern Range (ER)



M. Gawel/ER

C-band Radar Contingency

- **ISS Visiting Vehicles (VV) are not routinely supported by the Department of Defense (DoD) C-band Radars. If a contingency is declared by the ISS Ground Controller (GC) during a VV mission, the ranges have agreed C-band radars will provide VV contingency support within agreed upon call-up times for Nominal and Off-duty hours. Support will be provided on a best-obtainable basis**
- **ISI for C-band Radar Contingency Call-up Procedures will be published prior to mission**
- **Prior to L-10 ER will send any updates for Points of Contacts (POC) for ISI**
- **ER will provide radar status prior to the mission to the Human Spaceflight (HSF) Network Director (ND) and Spaceflight Mission Manager (SMM)**

C-band Radar Contingency (cont'd)

- **Procedure**
  - **ISS GC will declare a VV contingency**
  - **ISS GC will announce whether C-band radar support is needed**
  - **All declared VV contingencies will be confirmed via E-mail, facsimile or memorandum from ISS GC to DoD Track**
  - **DoD Track will schedule C-band radar support**
    - **DoD Track has normal and off operating hours and points of contact for supporting radar sites identified in ISI**
  - **Following termination of contingency conditions, the ISS GC will verbally notify SMM and/or DoD Track to release C-band radar sites from support**
  - **ISS GC will also release confirmation message as soon as possible**

Flight Dynamics Facility (FDF)

W. Mitchell/FDSS

IN Element Status – FDF

- **Operational Changes since Soyuz 30 MORR**

Type	System	Significant Changes
Software	None	None
Hardware	None	None

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

Type	System	Significant Changes
Software	None	None
Hardware	Two-Line Elements (TLE)	Verify receipt/processing of Soyuz 31 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 31 Mission Support Plan (MSP) will be delivered by 07/01/12**
- **Summary and Readiness Assessment**
  - **FDF is ready to support the Soyuz 31/Expedition 32 and ISS Increment 32**

Communications Service Office (CSO)

R. Honeycutt/NICS

IN Element Status – CSO

- **Operational Changes since Soyuz 30 MORR**

Type	System	Significant Changes
Software	None	None
Hardware	MOVE Type "D" Keyset Retrofit	• 414 Type D Keysets deployed at GSFC (379 installed with 35 spares) • All 414 keysets have been retrofitted and 379 deployed as of 04/20/12
	IDEA/IIGoR	• The MCC and MSFC teams successfully transitioned the ISS Ku-Band data from the IDEA network to the IIGoR network on 05/10/12 • IDEA is scheduled to be turned down on 07/01/12

- **Marshall Space Flight Center (MSFC) Russian Services: No changes**
- **Open NICS Information Technology Service Management (NITSM) Tickets: None**

IN Element Status – CSO (cont'd)

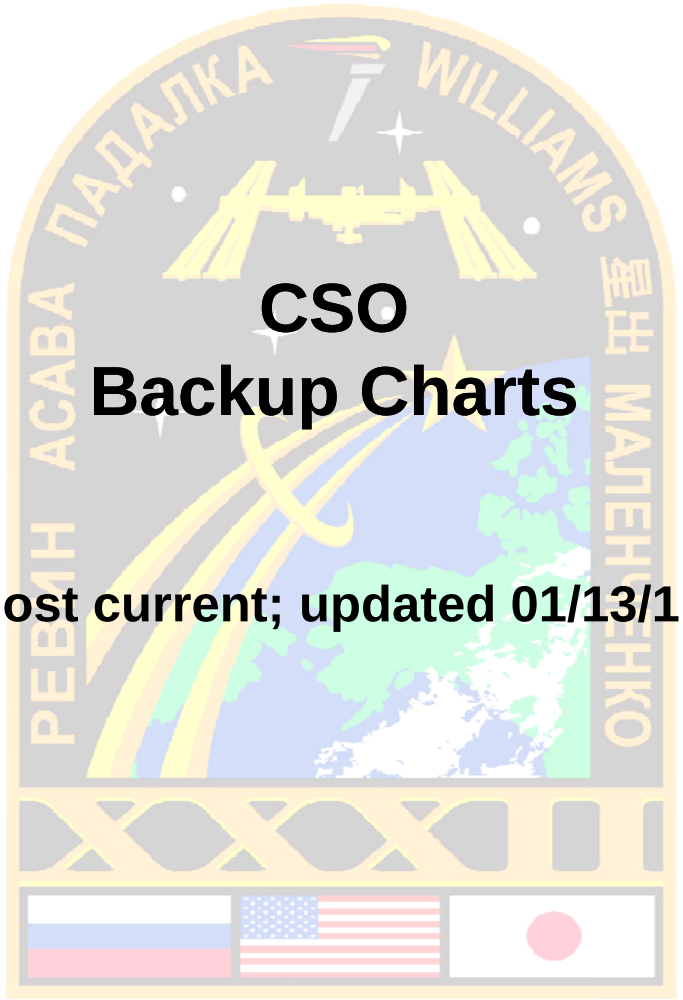
- **Open Work**

Type	System	Significant Changes
Software	None	• None
Hardware	Nortel Router Project Upgrade	• Current Network routers are obsolete and not supported by vendor • All equipment has been delivered to sites and in different stages of installation by Host Centers • No new routers have been connected to the operational Network • Test Readiness Review (TRR) was completed on 03/04/12 • Project completion date currently scheduled for April or May timeframe 2013
	Marshall Space Flight Center (MSFC) Small Conversion Device (SCD)	• The MSFC SCD had buffering problems with the HTV-3 commands which caused a 19 second delay in the commands from JAXA • A new SCD loaded with the upgraded 7.0 software was shipped to MSFC • This upgraded software is supposed to mitigate the command delay from 19 seconds to 2 seconds • We are awaiting word from MSFC that the SCD, which is a replacement for SCD 4, is installed and operational

- **Projected Changes: None**

IN Element Status – CSO (cont'd)

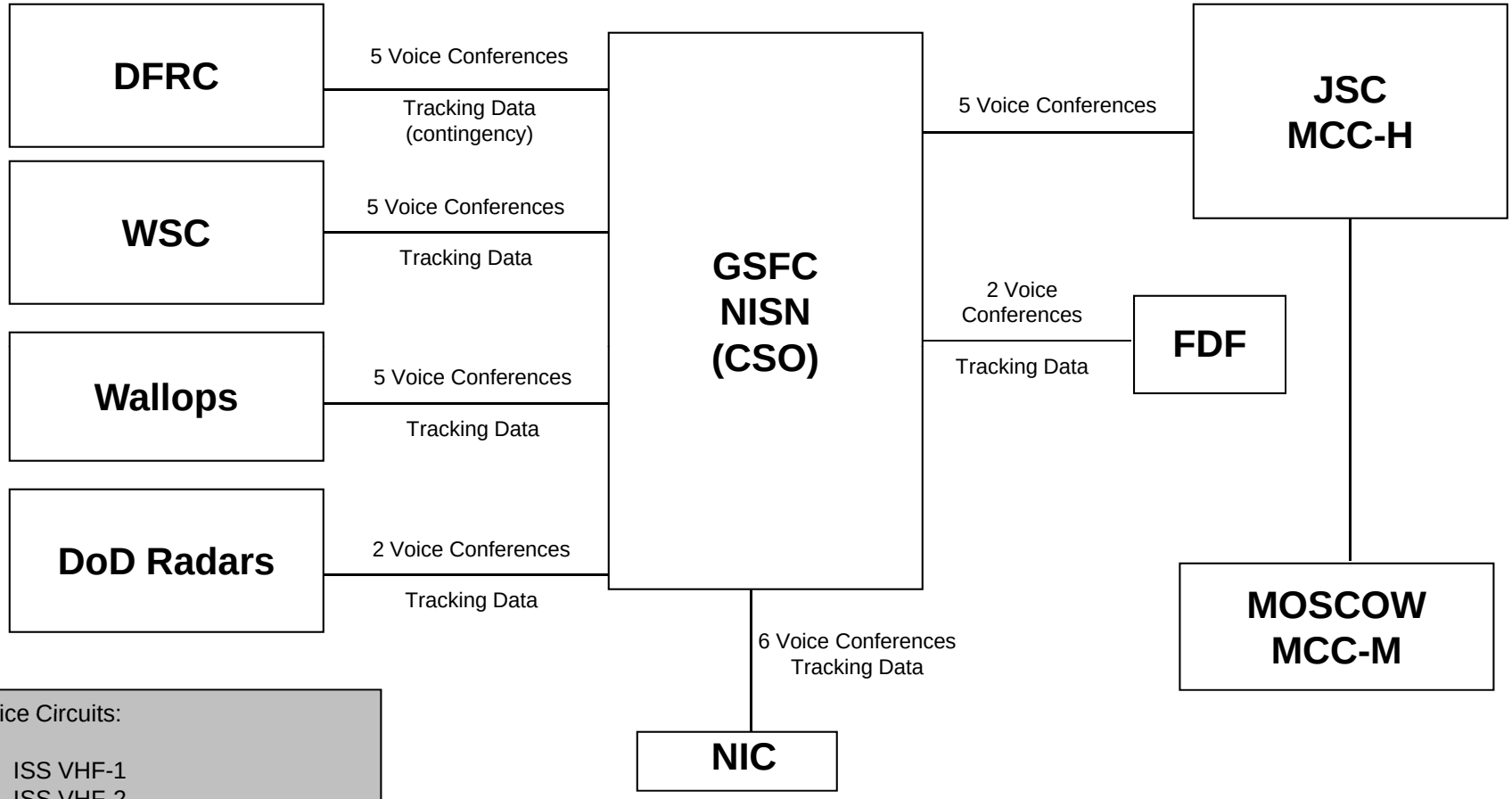
- **Staffing, Training and Certification**
  - **Staffing is sufficient to meet all requirements**
- **Documentation Status**
  - **Documentation is up to date**
- **Summary and Readiness Assessment**
  - **CSO will process all FER during mission in accordance with NISN SOP-002, published 10/2009**
  - **CSO is ready to support the Soyuz 31/Expedition 32 and ISS Increment 32**



CSO
Backup Charts

(Most current; updated 01/13/11)

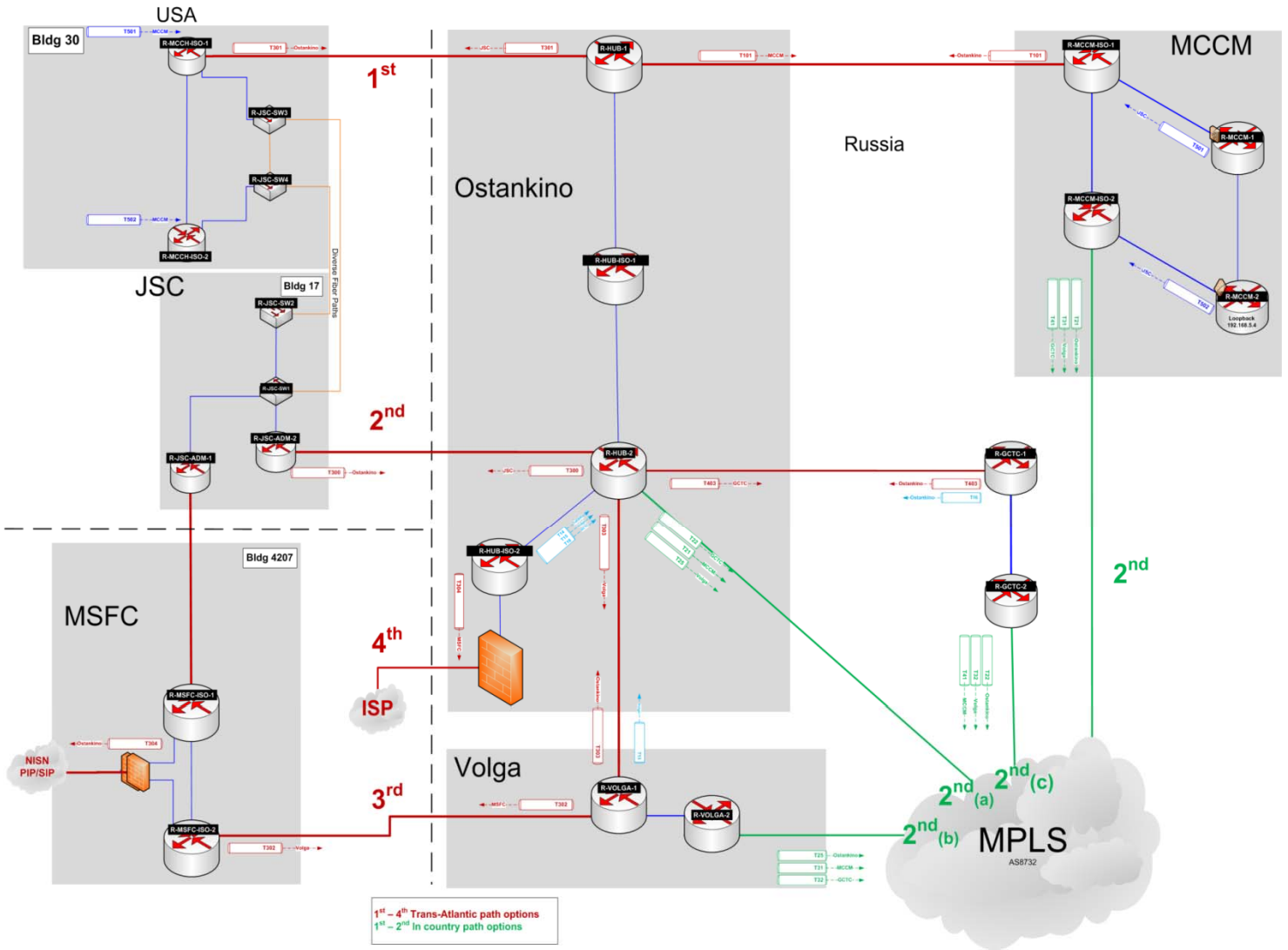
Soyuz IN Voice and Data Circuits

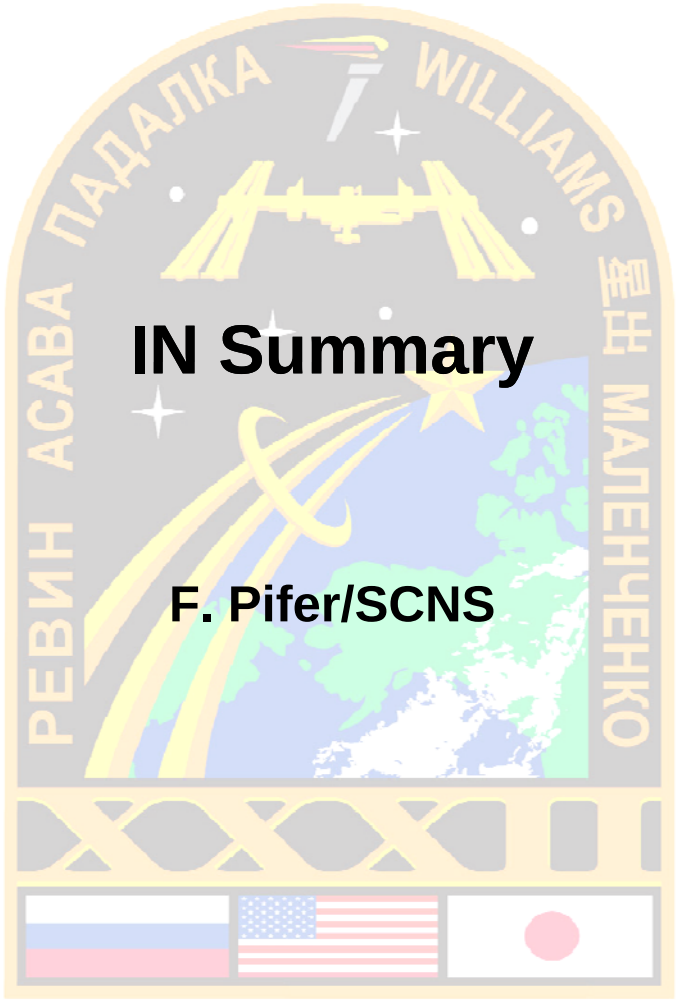


Voice Circuits:

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

Russian Mission Network Backbone





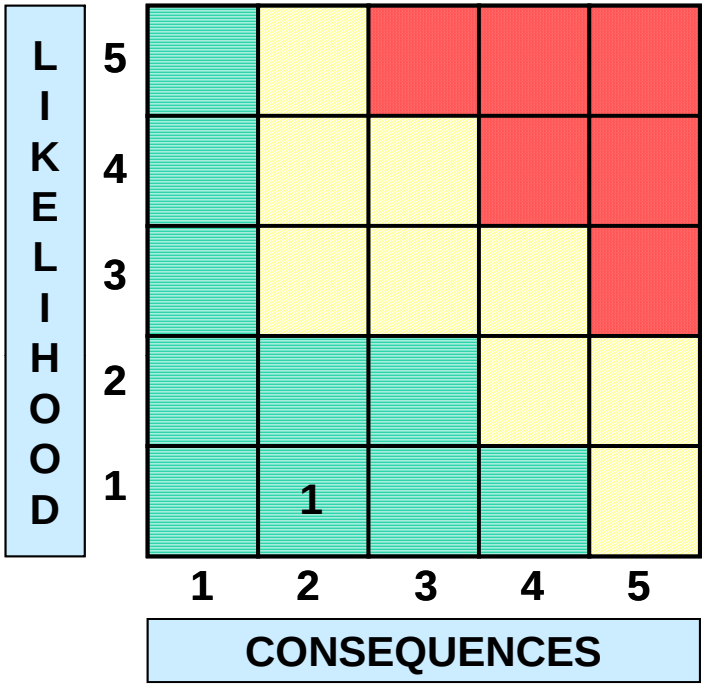
IN Summary

F. Pifer/SCNS

Requirements/Test Matrix

Network Resource	Requirement	Verification Method	Verification Complete
SN	• 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)	TBD
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)	12/26/11
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)	02/23/12
VHF Proficiency Simulations	• Insure VHF station operator proficiency for configuring communications support to ISS	Pre-pass and Post-pass interface procedures performed per documented procedures	DFRC & WGS 05/01/12
ER	• C-band metric data support, tracking of Soyuz for VHF-2, and C-band slaving at DFRC for emergency support only	Operational – contingency support only	Operational
CSO	• Voice/Data Communications	Operational	Operational
FDF	• 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

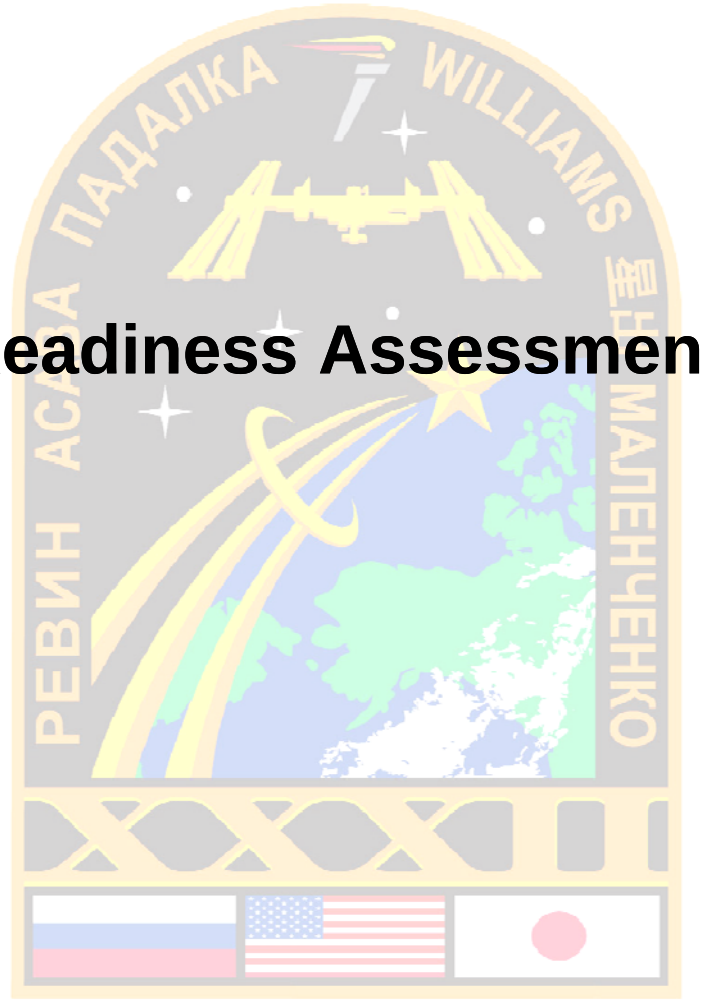
VHF-2 Risk

Rank	Risk Statement	Approach & Plan	Comments
1 L	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 WGS 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

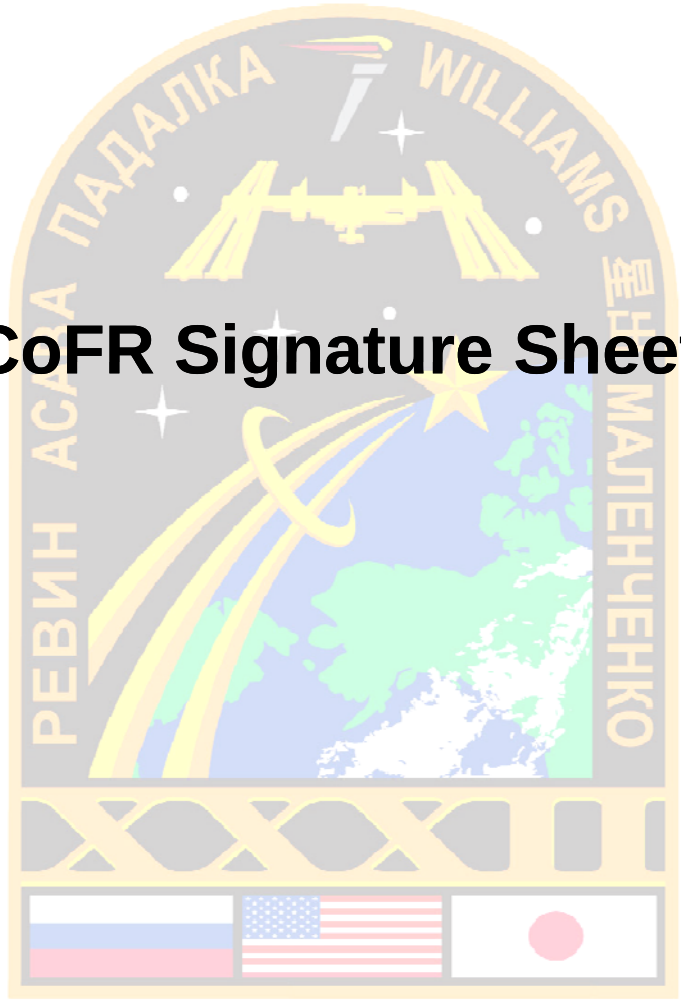
Risk Criticality	H	M	L

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-31/Expedition 32 mission

5/30/12

Carolyn P. Dent, Chairperson, Code 301, GSFC, Systems Review Office — **Date**

for

Bradford Butts, Code 761 GSFC, Systems Management Branch — **Date**

Scott A. Greatorex, Code 450.1 GSFC, Chief, Networks Integration Management Office — **Date**

5/30/2012

Joseph M. Aquino, JSC, Code DD13 Manager Space Communications Integration Office — **Date**

for 5/30/12

Susan L. Hoge, Code 595 GSFC, Navigation and Mission Design Branch — **Date**

Marco M. Midon, Code 453 GSFC, Ground Network Project — **Date**

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-31/Expedition 32 mission

Donald W. Shinners 5/31/12

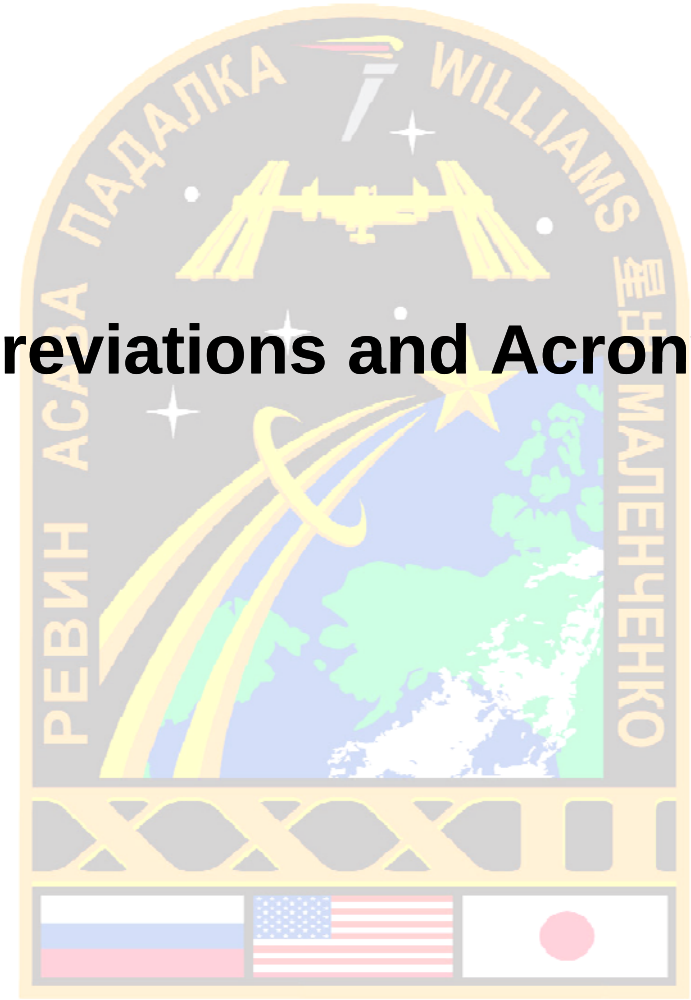
Donald W. Shinners, Code 452
GSFC, Space Network Project
Date

James A. Bangerter 5/30/12

James A. Bangerter, Code 450.1
GSFC, Human Spaceflight Network Director
Date

For Michael Yettaw 5/30/12

Michael E. Yettaw
Range Technical Monitor, Western Aeronautical Test Range (WATR)
Date



Abbreviations and Acronyms

Abbreviations and Acronyms

CoFR	Certificate of Flight Readiness
CCB	Configuration Control Board
CSO	Communications Service Office
DoD	Department of Defense
DCN	Document Control Number
DFRC	Dryden Flight Research Center
DIS	Data Interface System
DR	Discrepancy Report
ER	Eastern Range
ETE	End-to-End
ETGT	Extended TDRS Ground Terminal
FD	Flight Director
FDF	Flight Dynamics Facility
FER	Freeze Exemption Requests
FRR	Flight Readiness Review
GC	Ground Controller
GMT	Greenwich Mean Time
GN	Ground Network
GRGT	Guam Remote Ground Terminal
GSFC	Goddard Space Flight Center
H/W	Hardware
HPA	High Power Amplifier
HSF	Human Space Flight
HVAC	Heating, Ventilating and Air Conditioning
IN	Integrated Network
I/O	Input/Output
ISI	Interim Support Instruction
ISS	International Space Station
JSC	Johnson Space Center
KSA	Ku-band Single Access
KSC	Kennedy Space Center
LOP	Local Operating Procedures
LSR	Low Sample Rate
MCC	Mission Control Center
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
MSP	Mission Support Plan
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications
NCCDS	Network Control Center Data System
ND	Network Director
NIC	Network Integration Center
NIMO	Networks Integration Management Office
NISN	NASA Integrated Services Network
NSR	NISN Support Request
ODAR	Obsolescence Driven Avionics Redesign
ORR	Operational Readiness Review
PMDS	Problem Management Dispatch System
POC	Point of Contact
PRD	Program Requirements Document
RF	Radio Frequency
SCD	Small Conversion Device
SCNS	Space Communications Network Services
SGLT	Space-to-Ground Link Terminal
SMM	Spaceflight Mission Manager
SN	Space Network
SORR	Stage Operations Readiness Review
STGT	Second TDRSS Ground Terminal
S/W	Software
TBD	To Be Determined
TDRS	Tracking and Data Relay Satellite
TDRSS	Tracking and Data Relay Satellite System
TLE	Two-Line Elements
UPS	Uninterruptible Power Supply
VHF	Very High Frequency
VV	Visiting Vehicle
WGS	Wallops Ground Station
WR	Western Range
WSC	White Sands Complex
WSGT	White Sands Ground Terminal