ISS/Soyuz VHF Support Team

Network Support Group (NSG)

VHF Ground Station Status
10/18/11

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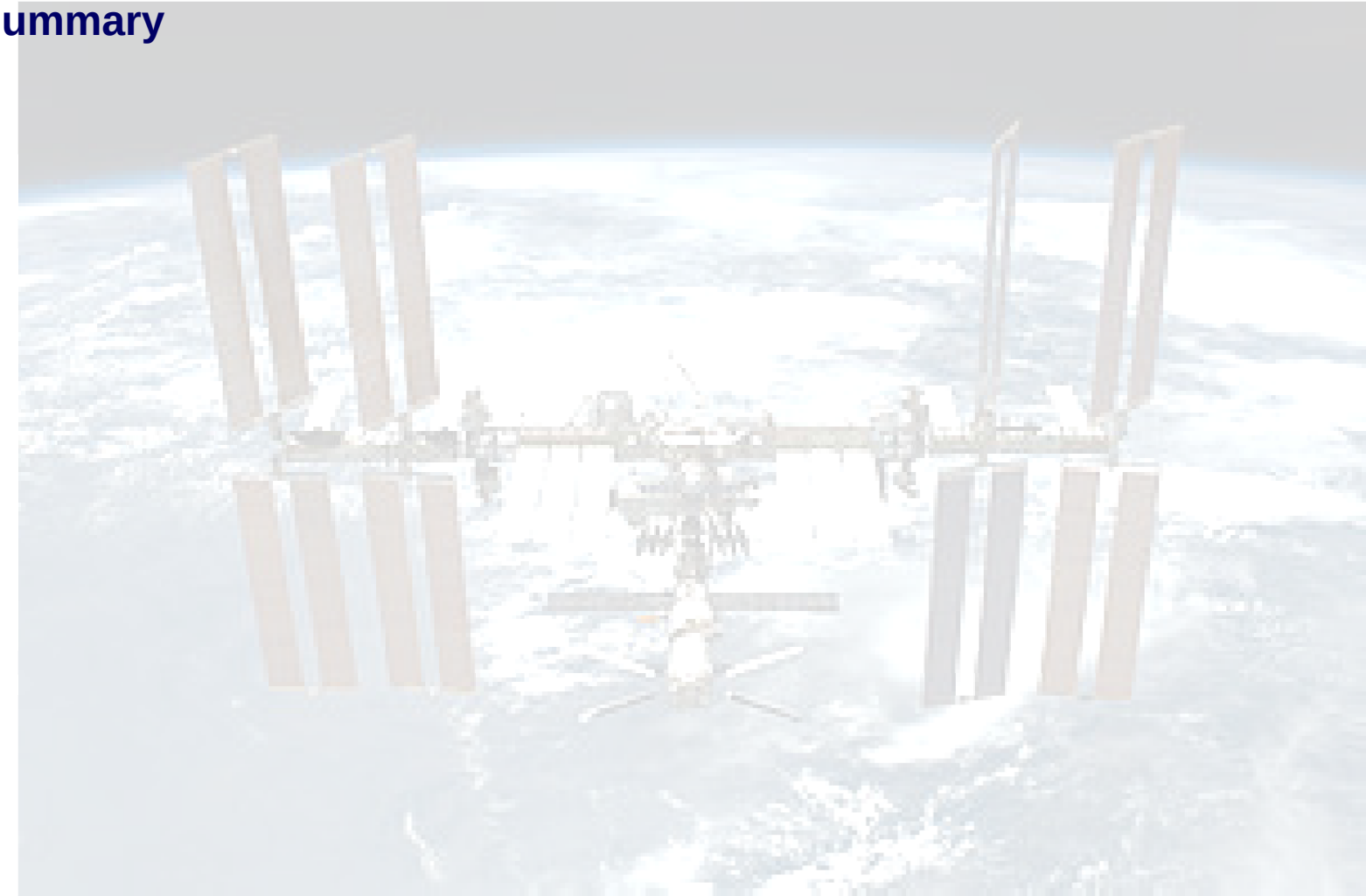
Agenda

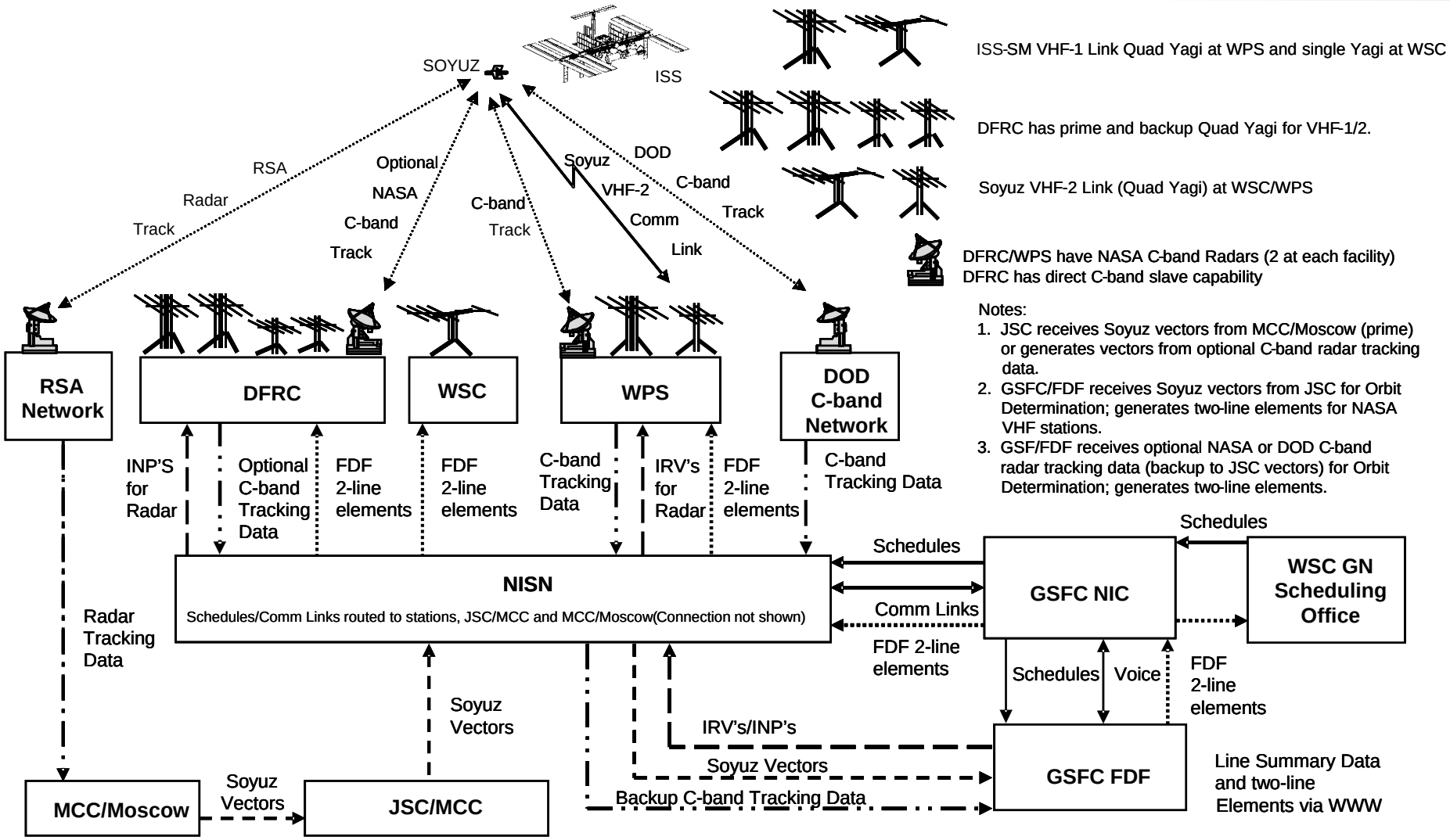
- U.S. Very High Frequency (VHF) Network Configuration
- Station Support Requirements
- Station Equipment Configuration
- Station Equipment List
- Hardware Status WGS/WSC
- Hardware Status/WSC Upgrades
- Documents
  - TDRSS Network Operations Support Plan (TNOSP)
  - Support Summaries
  - System Readiness Test (SRT) Report

Agenda Cont'd

- **Summary**



Network Configuration



Notes:

1. JSC receives Soyuz vectors from MCC/Moscow (prime) or generates vectors from optional C-band radar tracking data.
2. GSFC/FDF receives Soyuz vectors from JSC for Orbit Determination; generates two-line elements for NASA VHF stations.
3. GSF/FDF receives optional NASA or DOD C-band radar tracking data (backup to JSC vectors) for Orbit Determination; generates two-line elements.

Station Support Requirements

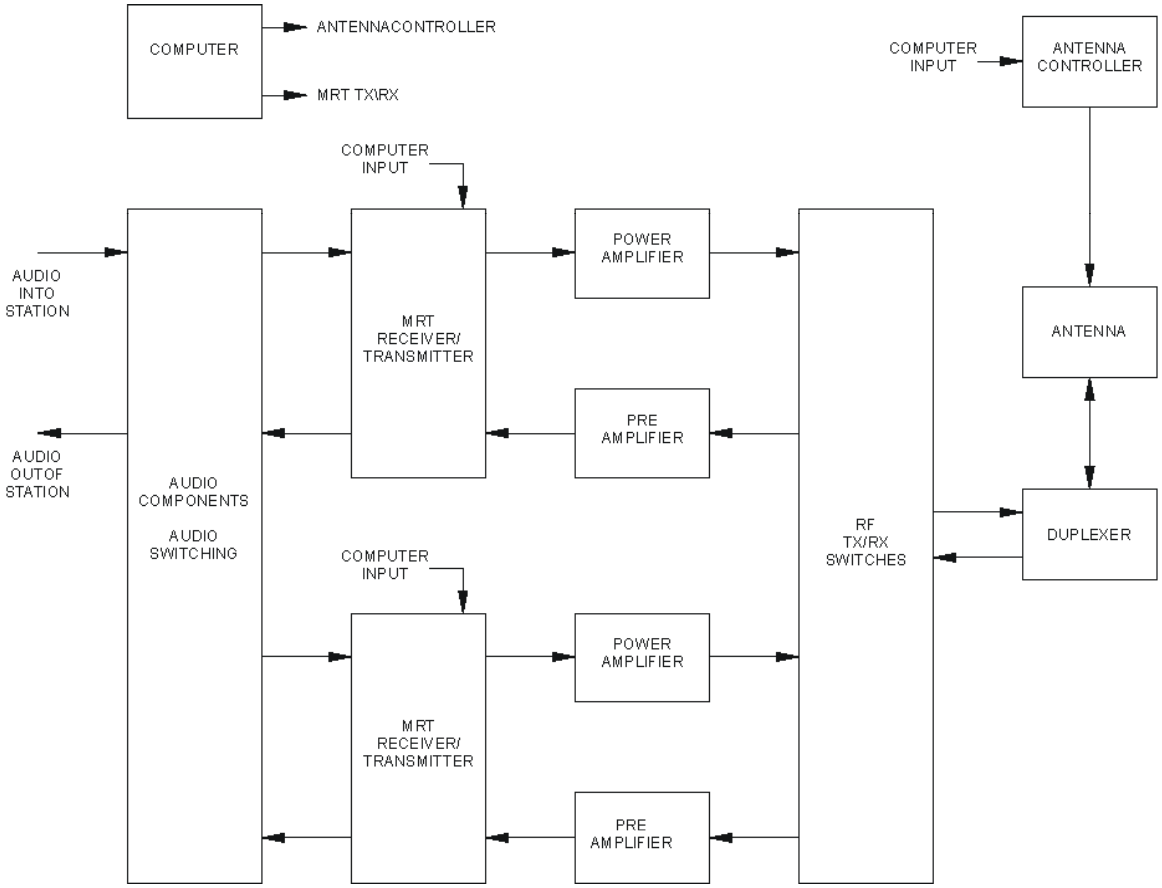
- Present station configuration supports ISS (VHF-1) and Soyuz (VHF-2) per Program Requirements Document (PRD)
- ISS VHF-1 support @ 139.208 MHz up and 143.625 MHz down
  - Voice support as scheduled
  - White Sands Complex (WSC) will not be scheduled below 20 degrees for test passes
  - All Stations available for emergency support
- Soyuz VHF-2 @ 130.167 MHz up and 121.750 MHz down
  - Voice downlink monitoring/emergency uplink only

Station Support Requirements

- VHF-1 Emergency Communication Verification Passes will be performed one per quarter per station (Not currently in the requirements)
  - Station operation's support proficiency will have to be reviewed
  - System software updates (Two-line elements) need to be checked weekly

Station Equipment Configurations

Wallops Ground Station (WGS)/Dryden Flight Research Center (DFRC) White Sands Complex (WSC) Single string WSC VHF-2



Station Major Component Equipment List

Station	ISS VHF-1	Soyuz VHF-2
Dryden Flight Research Center (DFRC)	139.208 MHz Up 143.625 MHz Down Full duplex no doppler compensation	130.167 MHz Up (Emergency only) 121.750 MHz Down Full Duplex no doppler compensation
	2 Independentsysterms with real-time selection capability: Prime Antenna: Quad Yagi Prime Transmit and Receive: MRT 1600A Prime Power Amp: TPL PA32LG HMS 500 watts Backup Antenna: Quad Yagi Backup Transmit and Receive: MRT 1600A Backup Power Amp: TPL PA32LG HMS 500 watts Antenna Controller/Nova S/W; C-Band slaving to local radar available Indepentent computers for prime and backup systems Capability to transmit on one system and receive on 2nd system to increase sensitivity (Receive Reverse switch)	2 Independent systems with real-time selection capability: Prime Antenna: Quad Yagi Prime Transmit and Receive: MRT 1600A Prime Power Amp: TPL PA32LG HMS 500 watts Backup Antenna: Quad Yagi Backup Transmit and Receive: MRT 1600A Backup Power Amp: TPL PA32LG HMS 500 watts Antenna Controller/Nova S/W; C-Band slaving to local radar available Indepentent computers for prime and backup systems Capability to transmit on one system and receive on 2nd system to increase sensitivity (Receive Reverse switch)

Station Major Component Equipment List (cont'd)

Station	ISS VHF-1	Soyuz VHF-2
Wallops Ground Station (WGS)	139.208 MHz Up 143.625 MHz Down Full duplex with doppler compensation	130.167 MHz Up (Emergency only) 121.750 MHz Down Full Duplex with doppler compensation
	Prime Antenna: Quad Yagi (Single Array; no backup) Dual transmit/receive systems strings with Radio Frequency (RF) switch Prime Transmit and Receive: MRT 1600A Prime Power Amp: TPL PA2CG HMS 350 watts Backup Transmit and Receive: MRT 1600A Backup Power Amp: TPL PA3CG HMS 350 watts 2 Indepentent computers for prime and backup systems with FODtrack S/W switchable to single Antenna Controller	Prime Antenna: Quad Yagi (Single Array; no backup) Dual transmit/receive systems with Radio Frequency (RF) switch Prime Transmit and Receive: MRT 1600A Prime Power Amp: TPL PA2CG HMS 350 watts Backup Transmit and Receive: MRT 1600A Backup Power Amp: TPL PA3CG HMS 350 watts 2 Indepentent computers for prime and backup systems with FODtrack S/W switchable to single Antenna Controller

Station Major Component Equipment List (cont'd)

Station	ISS VHF-1	Soyuz VHF-2
White Sands Complex (WSC)	139.208 MHz Up 143.625 MHz Down Full duplex with doppler compensation	130.167 MHz Up (Emergency only) 121.750 MHz Down Full Duplex with doppler compensation
	Prime Antenna: Single Yagi Transmit and Receive (no backup) Dual transmit/receive systems strings with Radio Frequency (RF) switch Prime Transmit and Receive: MRT 1600A Prime Power Amp: TPL 350 watts Backup Transmit and Receive: MRT 1600A Backup Power Amp: TPL 350 watts 2 Indepentent computers for prime and backup systems with FODtrack S/W switchable to single Antenna Controller	Prime Antenna: Quad Yagi (Single Array; no backup) Single transmit/receive systems with Prime Transmit and Receive: MRT 1600A Prime Power Amp: TPL PA2CG HMS 350 watts 2 Indepentent computers for prime systems with FODtrack S/W switchable to single Antenna Controller

Hardware Status WGS/WSC

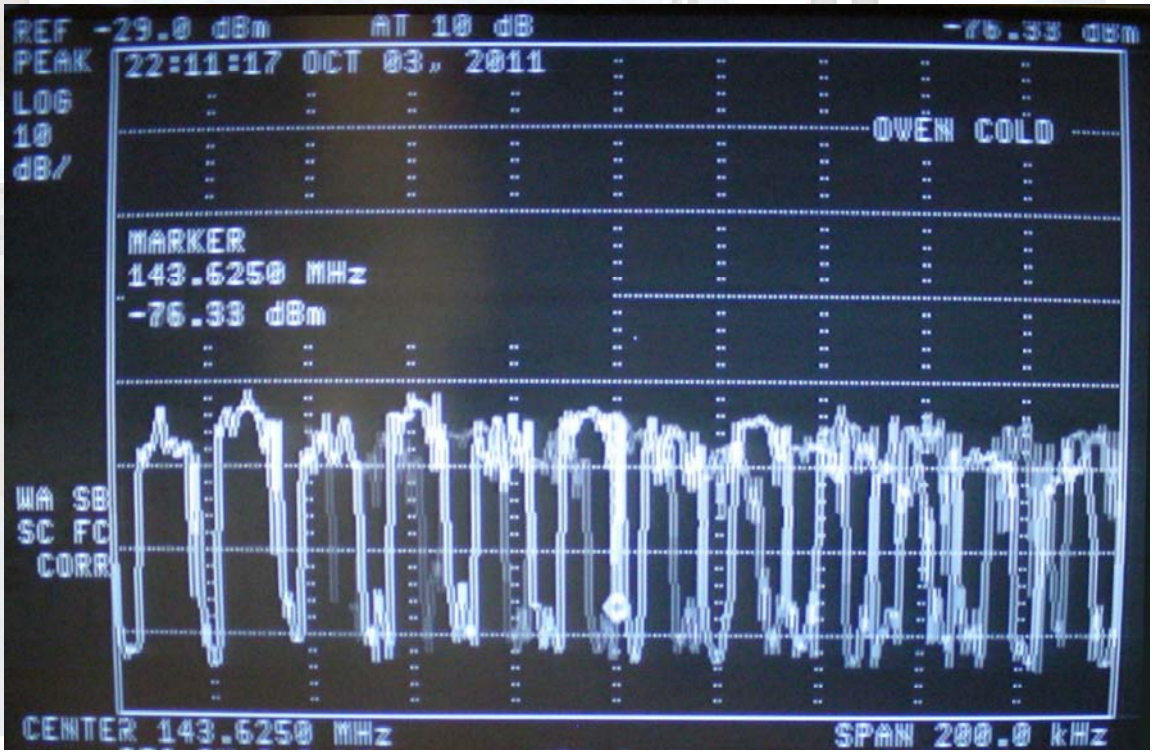
- Elevation drive motor obsolete
  - New elevation motor can be used with software upgrade to controller
- Repair of VHF system is handled locally
  - Modular Receiver/Transmitter (MRT) modules will be shipped to Goddard Space Flight Center (GSFC) for repair
- Inventory of spare hardware to be performed at Stations and Testbed

Hardware Status DFRC

DFRC ISS Support Issues

- Backup Quad PC replaced to mitigate flip mode problem on August ISS V1 support. (DR#1992 –closed)

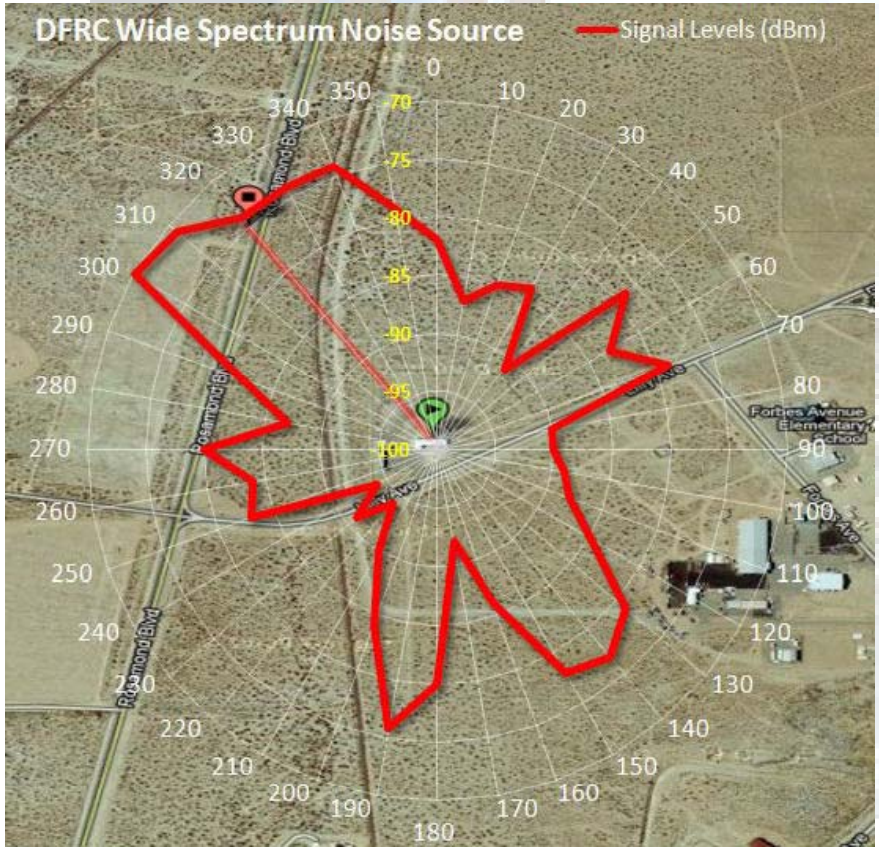
- Noise Encountered on 30 Sept 2011 V1 support at AOS. DR# 2009 - open.
  - Frequency MGT isolated problem to power line noise. Problem pending resolution.
  - Noise will affect passes with AOS Azimuths from 300 to 350 degrees. Noise becomes negligible at 10 degrees elevation.



Hardware Status DFRC

Interference problem - continued

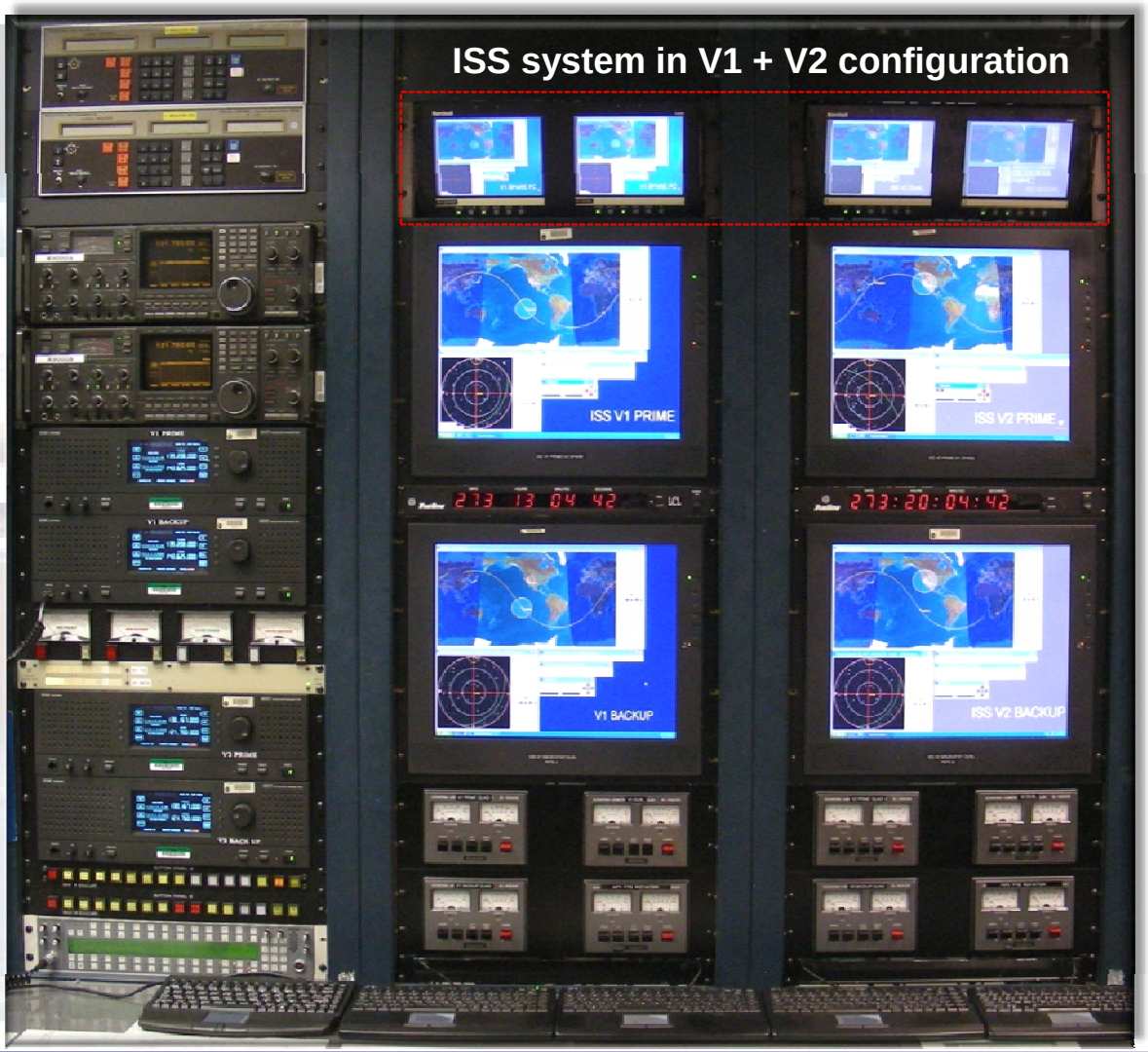
Interference Sweep 30 Sept 2011 – after ISS pass



Interference Sweep 12 Oct 2011 – After replacing insulators on 3 power poles

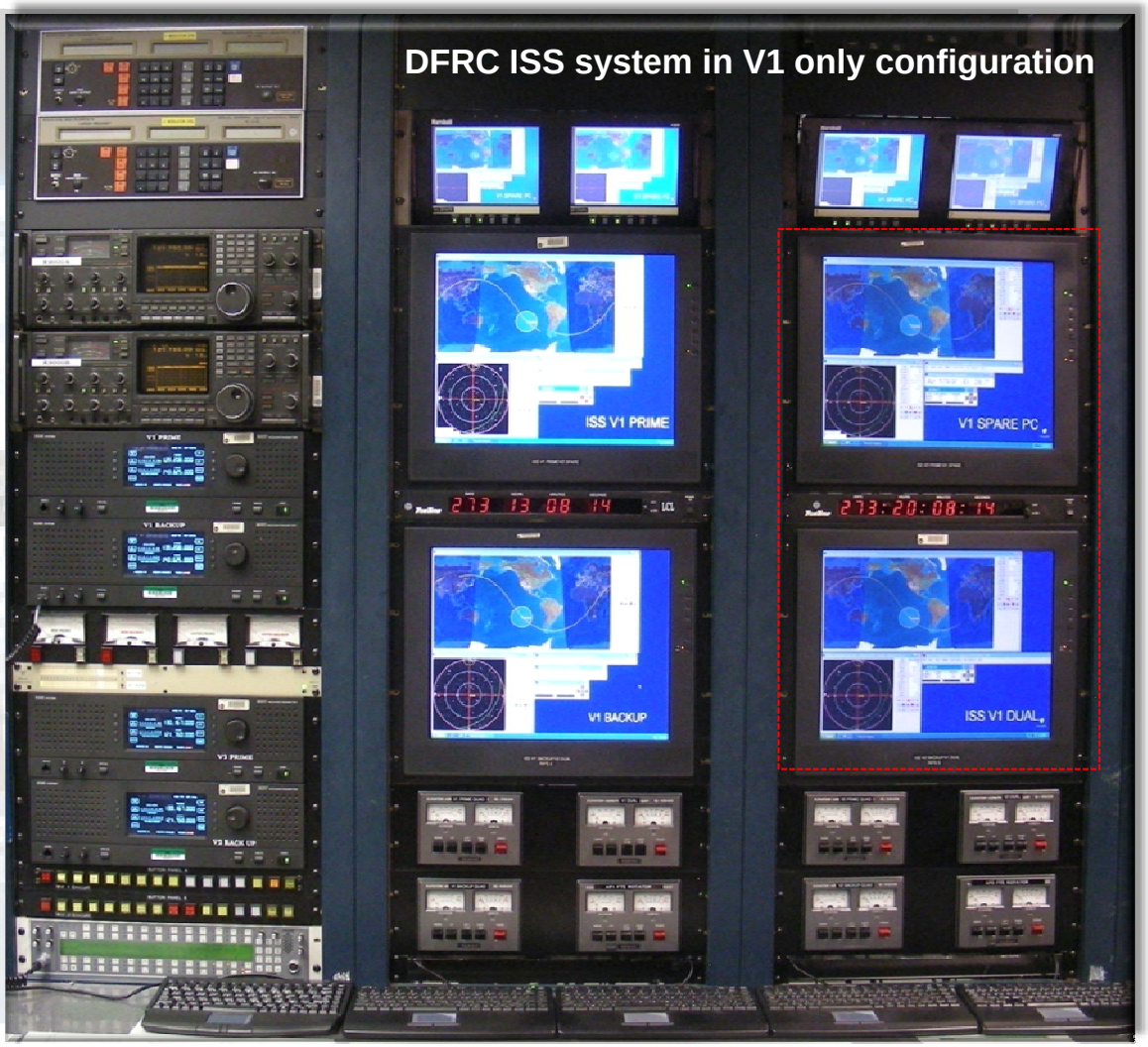
Hardware Status DFRC

- **ISS V1 / V2 system changes (CCR#4741)**
  - **Added V1 dual Yagi & V1 Spare PC - displayed on left small screens**
  - **Added V2 dual Yagi &V2 Spare PC – displayed on right small screens**
  - **Added antenna patch system to facilitate rapid antenna replacement**



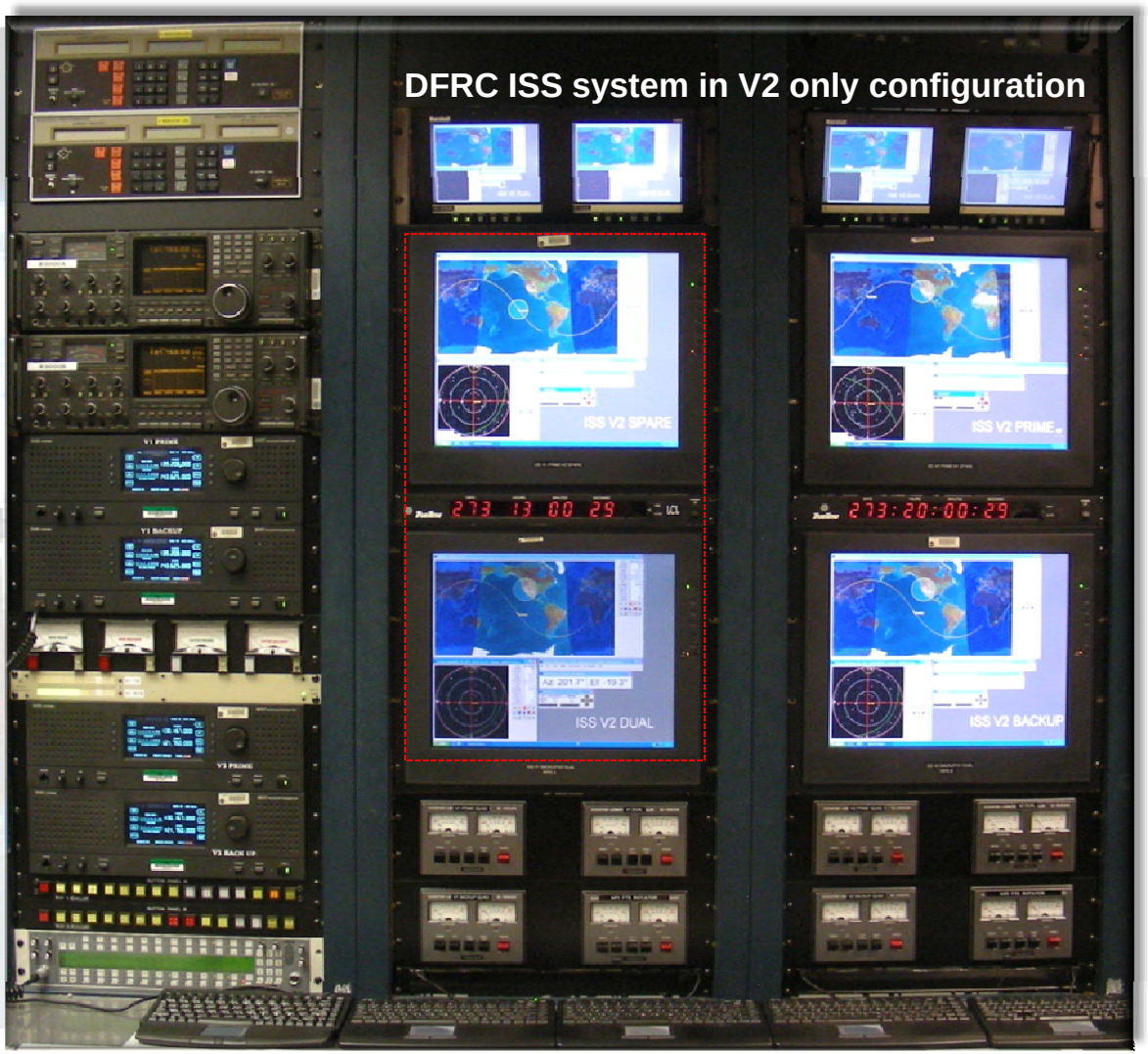
Hardware Status DFRC

- ISS V1 System changes (CCR 4721)
  - Added capability to display Spare V1 PC on large right top screen
  - Added capability to display V1 Dual Yagi on right bottom screen for real-time support



Hardware Status DFRC

- ISS V2 System changes (CCR 4721)
  - Spare V2 PC on large left top screen for real-time monitoring
  - V2 Dual Yagi on large left bottom screen for real-time support



Hardware Status WSC Upgrades

- **WSC Upgrades**
  - New TPL Communications power amplifier installed in VHF-1 system 2 (2/11)
  - Equipment shelter re-cabled (6/11)
  - Physically relocated equipment in shelter racks to maximize separation between transmit/receive (7/11)
  - System checked for proper grounding (7/11)
  - VHF-1 Quad Yagi Antenna/Tower placed on order (9/11)
    - VHF-2 will remain in place, VHF-1 will be on the new tower
  - New power divider/combiner to replace type-N tee connectors were installed and found to have excessive insertion loss (10/11)
    - Power dividers were removed the same day and are being evaluated/tested

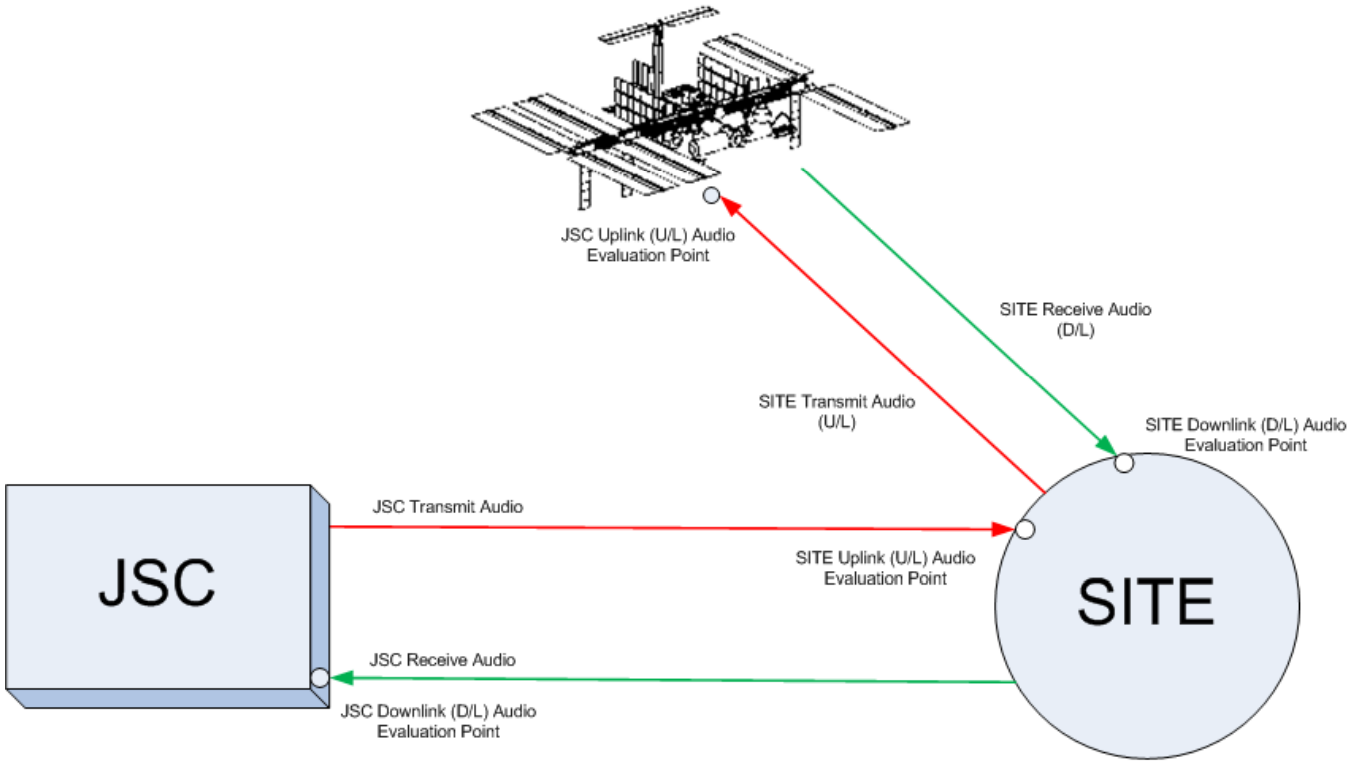
Hardware Status WSC Upgrades

- **WSC Upgrades (cont'd)**
  - **Procurement of labor to erect the tower on pre-existing pad is pending**
  - **Equipment Change (EC) TO015-12 (record capability) cancelled and to be included in antenna relocation EC**
    - **Both VHF-1/2 systems will have record capabilities**
    - **Transmit and receive will be on separate channels**

Documents

- TDRSS Network Operations Support Plan (TNOSP)
  - Under going a major rewrite and formatting
  - Specific sections to be addressed are the pre/post-pass briefing, VHF-2 transmission notification and the updated SRT
  - Support Summaries
    - Station will submit a standardized “VHF Support Summary” per the TNOSP VHF Annex
  - SRT
    - Stations will perform an SRT (bi-weekly) per the TNOSP VHF Annex (both systems VHF-1/2) and report completion via email to the SMM
- System equipment manual is being updated
  - All other equipment manuals are up to date

VHF Support Summary Evaluation Points



Audio Quality			
JSC		SITE	
UPLNK	DOWNLNK	UPLNK	DOWNLNK
5/5	4/4	5/5	3/2

Evaluate Audio Quality on a grade of 5 to 1 [Example: (5/5)
Where the first number is Audio Strength/Second number is Audio Clarity
Audio Strength Standard Scale, 5 thru 1
5) Loud 4) Good 3) Fair 2) Poor 1) Unreadable
Audio Clarity Standard Scale, 5 thru 1
5) Clear 4) Good 3) Fair 2) Poor 1) Unreadable

VHF Support Summary Audio Quality Evaluation Points

ISS VHF-1 Support Summary

(1) ISS VHF-1 Support Summary | (2) Page X of X

(3) VHF Daily Summary Report for XXX(X)

Julian Da	XXX					(5) Calendar Date	MM/DD/YYYY						(9) Remarks
(6) Pass #1						(7) Handover Times			(8) Audio Quality				
(a) Start	(b) Start	(c) Max	(d) Stop	(e) Stop	(f) Scheduled	(a) XXXX	(b) XXXX	(c) Time	(a) JSC		(b) XXXX		
Time	AZ	Elev.	Time	AZ	Time	Start	Stop	Supported	(i) UPLINK	(ii) DOWNLINK	(i) UPLINK	(ii) DOWNLINK	
00:00:00	0	0	00:00:00	0	00:00:00	00:00:00	00:00:00	TRUE	NA/NA	NA/NA	NA/NA	NA/NA	
Pass #2						Handover Times		Time	Audio Quality				
SITE	Start	Max	SITE		Scheduled	Site	Site	Site	JSC		SITE		
AOS	AZ	Elev.	LOS		Time	Start	Stop	Supported	UPLINK	DOWNLINK	UPLINK	DOWNLINK	
					00:00:00			00:00:00	NA/NA	NA/NA	NA/NA	NA/NA	
Pass #3						Handover Times		Time	Audio Quality				
SITE		Max	SITE		Scheduled	Site	Site	Site	JSC		SITE		
AOS		Elev.	LOS		Time	Start	Stop	Supported	UPLINK	DOWNLINK	UPLINK	DOWNLINK	
					00:00:00			00:00:00	NA/NA	NA/NA	NA/NA	NA/NA	
Pass #4						Handover Times		Time	Audio Quality				
SITE		Max	SITE		Scheduled	Site	Site	Site	JSC		SITE		
AOS		Elev.	LOS		Time	Start	Stop	Supported	UPLINK	DOWNLINK	UPLINK	DOWNLINK	
					00:00:00			00:00:00					
Pass #5						Handover Times		Time	Audio Quality				
SITE		Max	SITE		Scheduled	Site	Site	Site	JSC		SITE		
AOS		Elev.	LOS		Time	Start	Stop	Supported	UPLINK	DOWNLINK	UPLINK	DOWNLINK	
					00:00:00			00:00:00					
Predicted Page 1					00:00:00	Total Support Time Page 1		00:00:00					

Evaluate audio on a grade of 1 to 5 [Example: (5/5)} Audio Strength Standard Scale, 5 thru 1 Audio Clarity Standard Scale, 5 thru 1
Audio Strength is first number, Audio Clarity is secor5 Loud / 4 Good / 3 Fair / 2 Poor / 1 Unread5 Excellent / 4 Good / 3 Fair / 2 Poor / 1 Unrea

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Soyuz VHF Support Summary

(1) Soyuz-XX VHF-2 Support Summary

(2) Page X of X

(3) VHF Daily Summary Report for XXX(X)

	XXX					(5) Calendar Date	MM/DD/YYYY						(9) Remarks
(6) Pass #1						(7) Handover Times			(8) Audio Quality				
(a) Start	(b) Start	(c) Max	(d) Stop	(e) Stop	(f) Scheduled	(a) XXXX	(b) XXXX	(c) Time	(a) JSC		(b) XXXX		
Time	AZ	Elev.	Time	AZ	Time	Start	Stop	Supported	(i) UPLINK	(ii) DOWNLINK	(i) UPLINK	(ii) DOWNLINK	
00:00:00	0	0	00:00:00	0	00:00:00	00:00:00	00:00:00	TRUE	NA/NA	NA/NA	NA/NA	NA/NA	
Pass #2						Handover Times		Time	Audio Quality				
SITE	Start	Max	SITE		Scheduled	Site	Site	Site	JSC		SITE		
AOS	AZ	Elev.	LOS		Time	Start	Stop	Supported	UPLINK	DOWNLINK	UPLINK	DOWNLINK	
					00:00:00			00:00:00	NA/NA	NA/NA	NA/NA	NA/NA	
Pass #3						Handover Times		Time	Audio Quality				
SITE		Max	SITE		Scheduled	Site	Site	Site	JSC		SITE		
AOS		Elev.	LOS		Time	Start	Stop	Supported	UPLINK	DOWNLINK	UPLINK	DOWNLINK	
					00:00:00			00:00:00	NA/NA	NA/NA	NA/NA	NA/NA	
Pass #4						Handover Times		Time	Audio Quality				
SITE		Max	SITE		Scheduled	Site	Site	Site	JSC		SITE		
AOS		Elev.	LOS		Time	Start	Stop	Supported	UPLINK	DOWNLINK	UPLINK	DOWNLINK	
					00:00:00			00:00:00					
Pass #5						Handover Times		Time	Audio Quality				
SITE		Max	SITE		Scheduled	Site	Site	Site	JSC		SITE		
AOS		Elev.	LOS		Time	Start	Stop	Supported	UPLINK	DOWNLINK	UPLINK	DOWNLINK	
					00:00:00			00:00:00					
Predicted Page 1					00:00:00	Total Support Time Page 1		00:00:00					

Evaluate audio on a grade of 1 to 5 [Example: (5/5)} Audio Strength Standard Scale, 5 thru 1 Audio Clarity Standard Scale, 5 thru 1
Audio Strength is first number, Audio Clarity is secor5 Loud / 4 Good / 3 Fair / 2 Poor / 1 Unread 5 Excellent / 4 Good / 3 Fair / 2 Poor / 1 Unrea

450.1-Form-0014

VHF Support Summary Explanation

VHF PASS SUMMARY REPORT EXPLANATION

(1) **TITLE** - This is the title of the support taken (Soyuz-XX VHF-2/ISS VHF-1), where XX designates the Soyuz mission.

(2) **PAGE NUMBER** – Generally, 1 of 1 page containing one to five supports but, can be multiple pages (ex. 2 of 2), where X is the number of page(s).

(3) **VHF Daily Summary Report for XXX(X)** – This line designates the supporting station, where XXX(X) is the station's alpha designation code (i.e., WGS, WSC, DFRC).

(4) **JULIAN DATE** – This is the day of the year, where XXX is the numeric day-of-year.

(5) **CALENDAR DATE** – The calendar date, where "MM" is two digit month, "DD" is two digit day, and "YYYY" is four digit year.

(6) **PASS #** - This is the sequential incrementing number of the passes supported by the station during one zulu day (24 hour period, 0000Z-2359Z).

a. **START TIME** – The time in hh:mm:ss of the Station's zero degree elevation angle at the predicted Acquisition-of Signal (AOS).

b. **START AZIMUTH (AZ)** – The azimuth angle in degrees at the predicted zero degree elevation angle at AOS.

c. **MAXIMUM ELEVATION (MAX ELEV)** – The maximum elevation angle predicted during the pass.

d. **STOP TIME** – The time in hh:mm:ss of the Station's zero degree elevation angle at the predicted Loss-of-Signal (LOS).

e. **STOP AZIMUTH (AZ)** – The azimuth angle in degrees at the predicted zero degree elevation angle at LOS.

f. **SCHEDULED TIME** – The total time of the Station's predicted support period in hh:mm:ss.

(7) **HANDOVER TIMES** – (Leave blank for single station support)

a. **XXX(X) START** – This is the time briefed by the Houston Communications Technician (HCT) that the station will be the prime (cut-in)/active (VHF-1 carrier up) station for support, where XXX(X) is the station's alpha designation code.

b. **XXX(X) STOP** - This is the time briefed by the HCT that the station will become the secondary station (cut-out)/passive (VHF-1 carrier down) station for support, where XXX(X) is the station's alpha designation code.

c. **TIME XXX(X) SUPPORTED** – Total time (in hh:mm:ss) the Station supported if there was a "Handover" during the support [XXX(X) start minus XXX(X) stop].

(8) **AUDIO QUALITY** – (ref: 450-TNOSP-ISS VHF Annex, Pg.1-40, Table 1-4 "Standard Audio Strength and Clarity Evaluation Scale").

a. **JSC – (Briefed postpass by HCT)**

i. UPLINK – Evaluation of the audio on a grade of 1 to 5 [Example: (5/5)] as reported by the ISS crew member, where audio strength is first number, audio clarity is second number.

ii. DOWNLINK - Evaluation of the audio on a grade of 1 to 5 [Example: (5/5)] as reported by the Spacecraft Communicator (CapCom), where audio strength is first number, aduio clarity is second number.

b. **XXX(X)** – Where XXX(X) is the station alpha designation code.

i. UPLINK – Evaluation of the audio on a grade of 1 to 5 [Example: (5/5)] as perceived by the on Station technician, where audio strength is first number, audio clarity is second number.

ii. **DOWNLINK** - Evaluation of the audio on a grade of 1 to 5 [Example: (5/5)] as perceived by the on Station technician, where audio strength is first number, audio clarity is second number.

(9) **REMARKS** – Name or initials of supporting technician(s), general support comments (i.e. good comm., no comm., tracking only, etc.), Discrepancy Report (DR) or Comphrehensive Discrepancy System (CDS) report number, any comments or support details that aid in the evlauation of the communications or describe the system performance or configuration. Any comments that won't fit in the "Remarks" section of this report summary should be provided on a separate sheet (word or text document) refrenced in the "Remarks" section and attached with the report summary when emailed.

ISS VHF-1 Support Summary

Page 1

ISS Daily Summary Report of Support at XXX

Julian Date: 083 | Calendar Day: 24/Mar/10

Pass #1						Handover Times		Time	Audio Quality				Remarks
Start	Start	Max	Stop	Stop	Scheduled	DFRC	DFRC	DFRC	JSC		XXX		KR-Onboard was a bit low but
Time	AZ	Elev.	Time	AZ	Time	Start	Stop	Supported	UPLNK	DOWNLNK	UPLNK	DOWNLNK	readable. JSC heard low level at times. Gnd Sta D/L audio low
20:09:15	214	23	20:18:42	53	00:09:27	20:09:15	20:11:27	00:02:12	4/4	4/4	5/5	2/3	and scratchy (see attached doc)

Pass #2						Handover Times		Time	Audio Quality			
SITE	Start	Max	SITE		Scheduled	Site	Site	Site	JSC		SITE	
AOS	AZ	Elev.	LOS		Time	Start	Stop	Supported	UPLNK	DOWNLNK	UPLNK	DOWNLNK
					00:00:00			00:00:00				

Pass #3						Handover Times		Time	Audio Quality			
SITE		Max	SITE		Scheduled	Site	Site	Site	JSC		SITE	
AOS		Elev.	LOS		Time	Start	Stop	Supported	UPLNK	DOWNLNK	UPLNK	DOWNLNK
					00:00:00			00:00:00				

Pass #4						Handover Times		Time	Audio Quality			
SITE		Max	SITE		Scheduled	Site	Site	Site	JSC		SITE	
AOS		Elev.	LOS		Time	Start	Stop	Supported	UPLNK	DOWNLNK	UPLNK	DOWNLNK
					00:00:00			00:00:00				

Pass #5						Handover Times		Time	Audio Quality			
SITE		Max	SITE		Scheduled	Site	Site	Site	JSC		SITE	
AOS		Elev.	LOS		Time	Start	Stop	Supported	UPLNK	DOWNLNK	UPLNK	DOWNLNK
					00:00:00			00:00:00				

Predicted Page 1 00:09:27 | Total Support Time Page 00:02:12

Evaluate audio on a grade of 1 to 5 [Example: (5/5)]
Audio Strength is first number, Audio Clarity is second number.

Audio Strength Standard Scale, 5 thru 1
5 Loud / 4 Good / 3 Fair / 2 Poor / 1 Unreadable

Audio Clarity Standard Scale, 5 thru 1
5 Excellent / 4 Good / 3 Fair / 2 Poor / 1 Unreadable

Summary

- The current VHF station configurations comply with the PRD
- WSC system upgrade in progress
- A rewrite of the TNOSP VHF Annex is in process
- An ISS VHF Support Summary is to be submitted by each station after a VHF Emergency Communications Verification pass or after a series of passes
  - Form is now on Next Generation Integrated Network (NGIN)
- SRT performed on VHF-1/2 on a bi-weekly bases with completion email report to Spaceflight Mission Manager (SMM)