International Space Station (ISS)/Soyuz Very High Frequency (VHF) Status Network Support Group (NSG)

04/17/12
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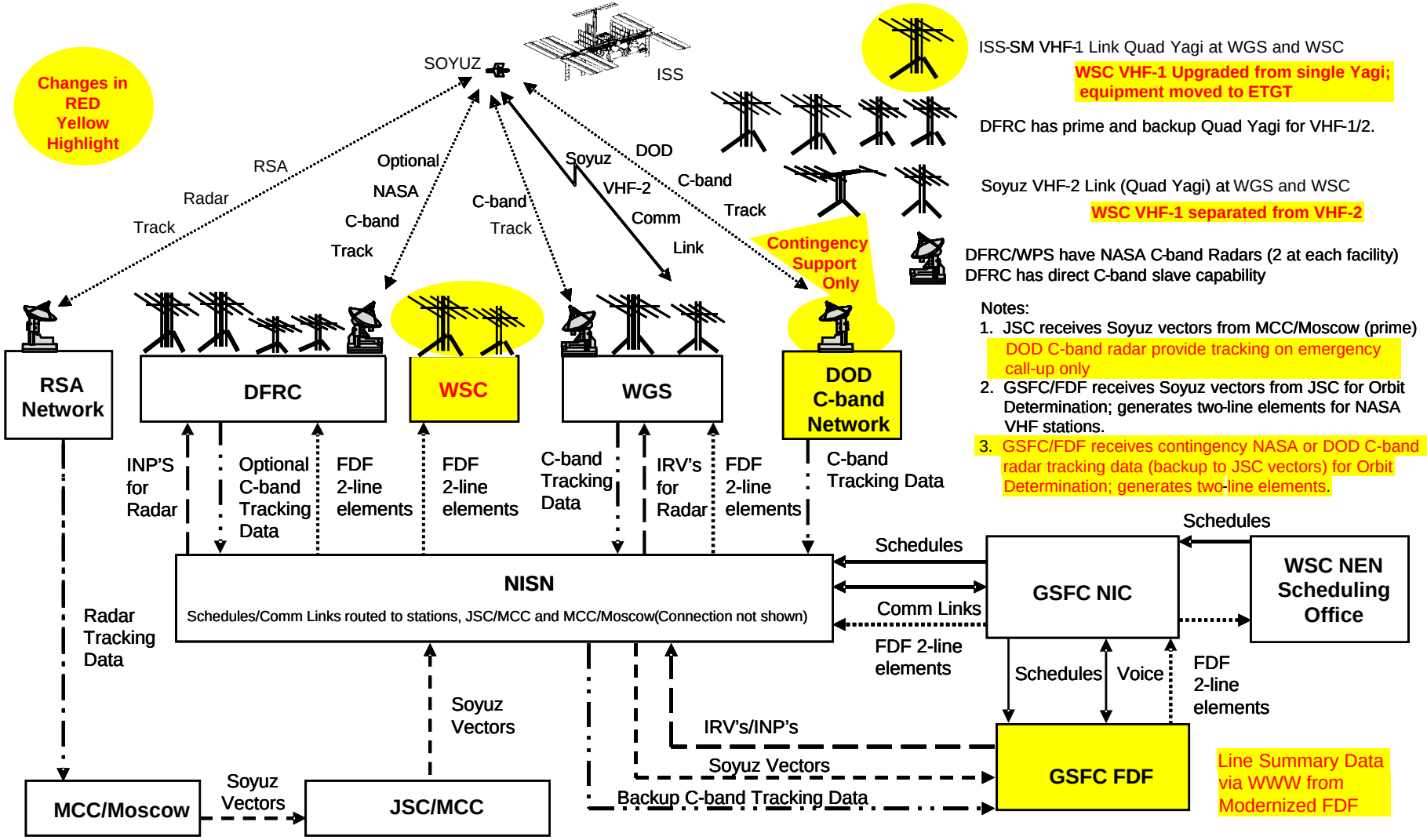
Agenda

- VHF Network Configuration
- Station Support
- Proposed Station Proficiency Simulations
- White Sand Complex (WSC) Upgrades
- Station Equipment Configurations
- Station Major Component Equipment List
- Documentation
  - Tracking and Data Relay Satellite System (TDRSS) Network Operations Support Plan (TNOSP) for the ISS VHF Annex
  - Support Summaries
  - System Readiness Test (SRT) Report
  - VHF Private Communications
  - Soyuz SIC and ID
- Summary
- Backup

VHF Network Configuration



Station Support

- **Stations provide contingency/emergency communications**
  - **ISS Service Module (SM) on VHF-1**
    - **139.208 MHz up/143.625 MHz down (contingency communications support)**
  - **Soyuz on VHF-2**
    - **130.167 MHz up/121.750 MHz down (emergency communications support only)**
    - **Monitor for downlink, report voice to Houston Communications Technician (HCT) and initiate uplink for emergency only**
  - **VHF-1 uplink radiation restricted pending license renewal (in work by Johnson Space center (JSC) Frequency Manager with approval date To Be Determined (TBD)**
    - **Restriction documented by OPN issued 03/19/12; radiation requires Flight Director (FD) or Network Director (ND) approval**
  - **WSC test passes not scheduled below 20 degrees (high noise environment)**
  - **All stations (including WSC) available for emergency support to ISS or Soyuz**

Station Support (cont'd)

- VHF-1 Emergency Communication Verification Passes
  - One pass per quarter per station
  - Station Proficiency Simulations proposed by Human Space Flight (HSF) Team
    - Simulated passes to be conducted with HCT
    - Exercise scheduling, interface, pass procedures and voice communications between JSC and stations
    - ISS Ground Controller (GC) initiates request per normal procedures
    - No ISS participation required, simulated support only
  - System software updates (Soyuz two-line elements) distributed via E-mail
    - Verified by Spaceflight Mission Manager (SMM) on regular basis
    - Goddard Space Flight center (GSFC) Communication Center updated for unique Soyuz mission support identification for each new mission

Proposed Station Proficiency Simulations

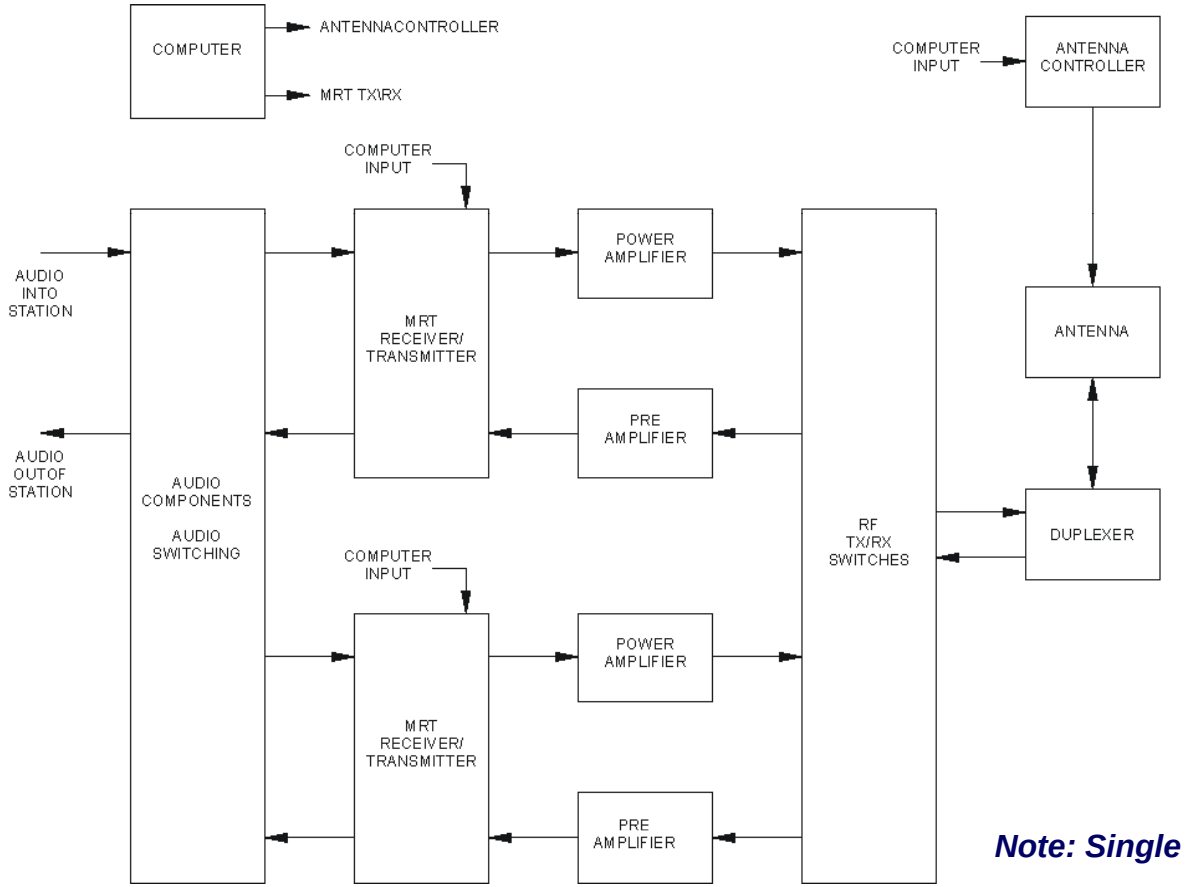
- **Proposed Station Proficiency Simulations**
  - **GC submit VHF schedule request**
    - **Comment section annotated “Emergency Communication Simulation Only”**
  - **Pre-pass briefing will advise station(s) pass is a simulation support**
    - **Stations will ensure the transmitter is configured to dummy load**
  - **WSC Near Earth Network (NEN) Scheduling Office (SO) will schedule the supporting station(s)**
    - **Normal scheduling guidelines; annotate activity section “Emergency Comm C/O Simulation only”**
  - **Stations (Dryden Flight Research Center (DFRC), Wallops Ground Station (WGS), and White Sands Complex (WSC)) will not radiate**
  - **Pass will be conducted in accordance with ISS TNOSP VHF Annex H-90 Interface and Pass/Post-pass Activities**

WSC Upgrades

- **WSC Upgrades**
  - **VHF-1 Quad Yagi Antenna/Tower installation completed 03/09/12**
    - **Equipment relocated to Extended TDRS Ground Terminal (ETGT)**
    - **Tone checks; JSC to ETGT and ETGT to JSC completed 03/19/12**
    - **Elevation drive damage reported 03/21/12; system status turned red**
      - **Vendor contacted for assistance; replaced elevation drive positioner on 04/03-04/12**
    - **WSC reported voice configuration issue on 03/28/12**
      - **Receiver voice being echoed by Mission Operations Voice Enhancement (MOVE) system expected to cause unacceptable echo in Astronaut headsets under investigation**
  - **VHF-2 Quad Yagi remains in place (existing tower)**
    - **Minor reconfigurations of equipment in racks**
    - **Voice interfaced to MOVE system**

Station Equipment Configurations

DFRC, WGS, and WSC



Note: Single string WSC VHF-2

Station Major Component Equipment List

Station	ISS VHF-1	Soyuz VHF-2
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 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 Independent 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 Independent 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
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 Independent 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 Independent 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
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: **Quad Yagi on new tower (Single Array; 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 Independent computers for prime and backup systems with FODtrack S/W switchable to single Antenna Controller **Equipment relocated to ETGT** **Audio interfaced to MOVE system**	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 Independent computers for prime systems with FODtrack S/W switchable to single Antenna Controller

Changes in RED Bold

Documentation

- **TNOSP for the ISS Revision 1 – VHF Voice Communications Support Annex**
  - **Major rewrite in progress with formatting changes**
  - **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**
    - **WGS and WSC perform VHF-1/-2 SRT (bi-weekly) per the ISS TNOSP VHF Annex, stations report completion to SMM**
- **System equipment manual is being updated**
  - **All other equipment manuals are up to date**

Documentation

- **VHF Private Communications**
  - **Integrated Network elements and VHF stations required to terminate all audio monitoring and recording on prior notice (scheduled support)**
    - **Mission Operations Voice Enhancement (MOVE) system reported to have no provision for canceling recording of digital voice**
- **Soyuz SIC and ID designations assigned as follows:**

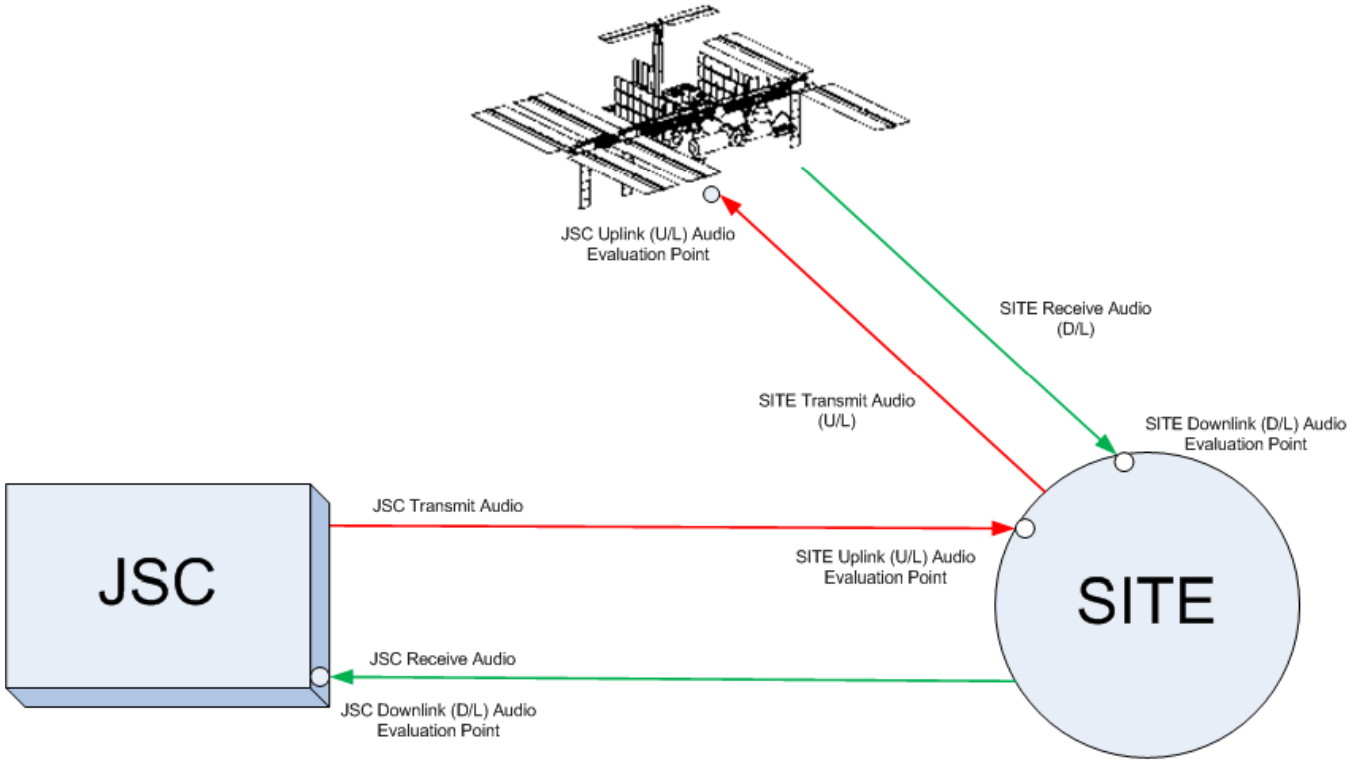
Launch Vehicle	SIC Assigned	FDF-Assigned ID
Russian Soyuz TMA-22M/28S	7928	11999C
Russian Soyuz TMA-03M/29S	7929	12999A
Russian Soyuz TMA-04M/30S	7930	12999B
Russian Soyuz TMA-05M/31S	7931	12999C
Russian Soyuz TMA-06M/32S	7932	12999D

Summary

- Current VHF station configurations comply with the Program Requirements Document (PRD)
- WSC system upgrade and testing successfully completed 03/19/12
  - VHF-1 elevation drive mechanical problems on 03/21/12 required vendor replacement of elevation positioner; on site testing completed 04/06/12
  - Voice echo issues with MOVE system remain in work
- TNOSP VHF Annex rewrite is in progress
- Support Summary required from each station after an Emergency Communications Verification Pass (or series of passes)
- SRT performed on VHF-1/2 on a bi-weekly basis at WGS/WSC
- DFRC performs non-invasive checks monthly; invasive checks quarterly
  - E-mail confirmation reported to SMM

Backup

VHF Support Summary Evaluation Points



Audio Quality			
JSC		SITE	
UPLINK	DOWNLINK	UPLINK	DOWNLINK
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)													
[illegible]	XXX					(5) Calendar Date	MM/DD/YYYY						(9) Remarks
(6) Pass #1						(7) Handover Times			(8) Audio Quality				
(a) Start Time	(b) Start AZ	(c) Max Elev.	(d) Stop Time	(e) Stop AZ	(f) Scheduled Time	(a) XXXX Start	(b) XXXX Stop	(c) Time Supported	(a) JSC (i) UPLINK	(a) JSC (ii) DOWNLINK	(b) XXXX (i) UPLINK	(b) XXXX (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													

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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)													
Station ID	XXX					(5) Calendar Date	MM/DD/YYYY						(9) Remarks
(6) Pass #1						(7) Handover Times			(8) Audio Quality				
(a) Start Time	(b) Start AZ	(c) Max Elev.	(d) Stop Time	(e) Stop AZ	(f) Scheduled Time	(a) XXXX Start	(b) XXXX Stop	(c) Time Supported	(a) JSC (i) UPLINK	(a) JSC (ii) DOWNLINK	(b) XXXX (i) UPLINK	(b) XXXX (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													

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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 Example

ISS VHF-1 Support Summary

Page 1

ISS Daily Summary Report of Support at XXX

Julian Date: 083 | Calendar Date: 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	UPLINK	DOWNLINK	UPLINK	DOWNLINK	readable. JSC heard low level at
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	times. Gnd Sta D/L audio low 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	UPLINK	DOWNLINK	UPLINK	DOWNLINK	
					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	UPLINK	DOWNLINK	UPLINK	DOWNLINK	
					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	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					

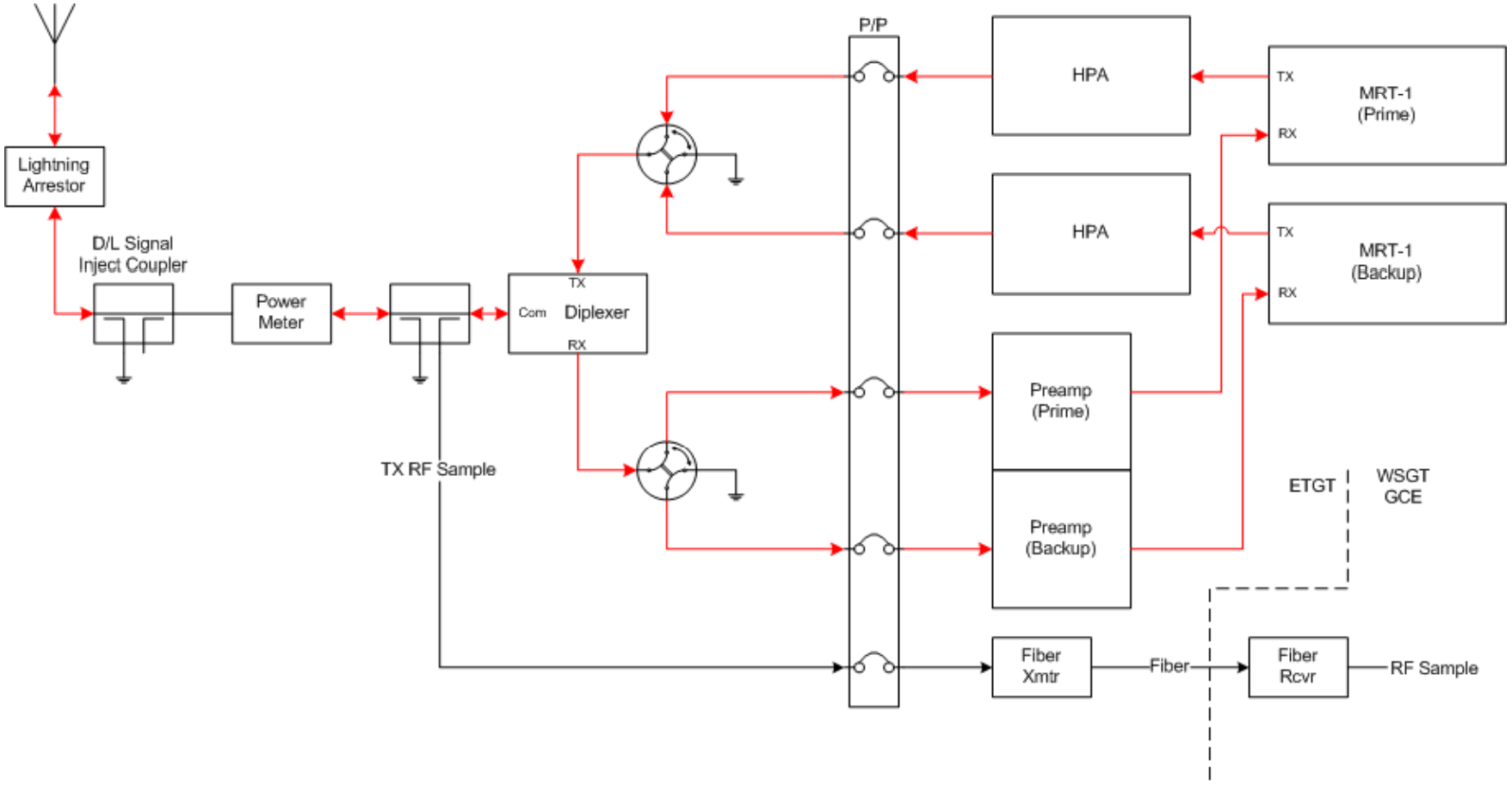
Predicted Page 1 00:09:27 | Total Support Time Page 00:02:12

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

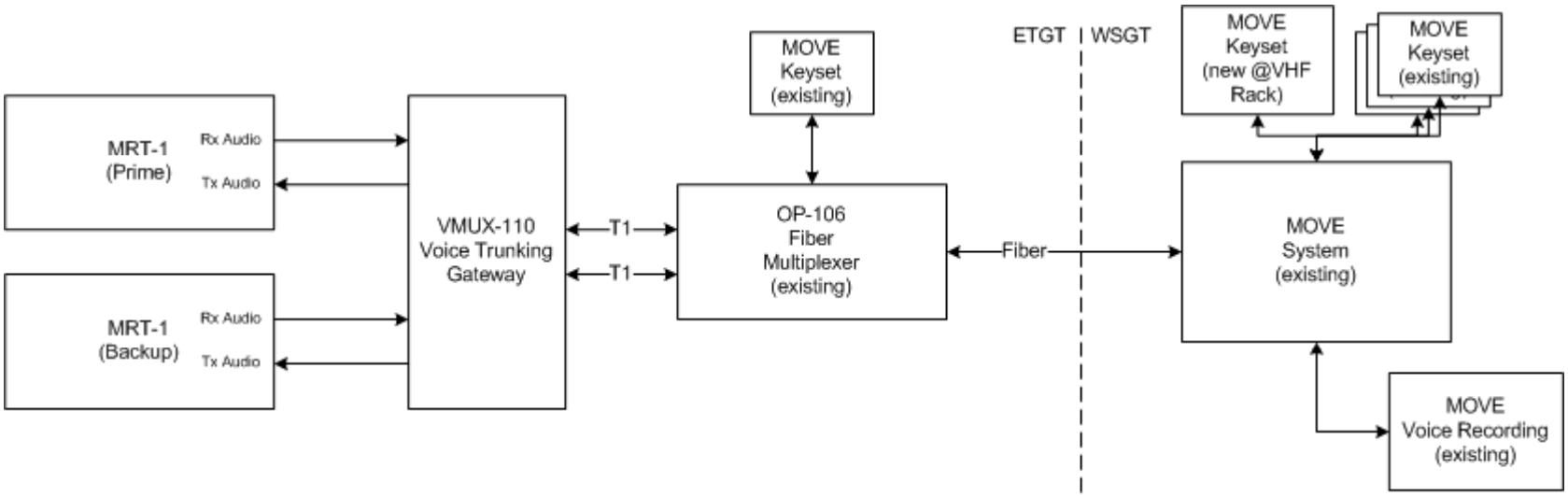
Audio Strength Standard Scale, 5 thru 1
5 Loud / 4 Good / 3 Fair / 2 Poor / 1 Unreadable

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

WSC Upgrade VHF-1 RF Signal Flow



WSC Upgrade VHF-1 Audio Signal Flow



WSC Upgrade VHF-1 Control and Status