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| VOICE AND AUDIO COMMUNICATIONS Interoperability Test Report |

Draft Yellow Book

19.02.2015

AUTHORITY

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FOREWORD

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* Swedish Space Corporation (SSC)/Sweden.
* Swiss Space Office (SSO)/Switzerland.
* United States Geological Survey (USGS)/USA.

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# INTRODUCTION

## 1.1 PURPOSE

The purpose of this document is to describe the verification of various operational scenarios for voice and audio communications (V&A) described in CCSDS 766.2-R-0, Proposed Draft Recommended Standard for voice and audio communications. All of the use cases stated in this book are currently in use on the International Space Station (ISS) and the extended ground segment including television and radio stations. Therefore, discreet testing or prototyping of use case scenarios from the voice book are not required.

## 1.2 SCOPE

The scope of this document is validation of both digital voice using the established communication networks (T1/E1) and VoIP over the same networks or public internet. Audio file transmission is considered standard file exchange using the AAC and Mpeg3 audio file formats. Voice communication systems for spacecraft applications and space to ground transmission are used in an everyday basis on the ISS.

Spacecraft-to-spacecraft are used between the Soyuz capsule and the ISS since several years, the same system was used between the ISS and the Space Shuttle, for these reasons prototyping and validation are also not part of this yellow book. This book does not call Astronaut to Spacecraft as a separate operational scenario. It is used in every EVA with Roscosmos or NASA space suits with the ISS and the MCCs. Rather, the operational scenarios in the voice and audio communications book can be applied to spacecraft-to-spacecraft as well as spacecraft-to-ground (4.1 and 6.1). The systems needed for transmission and reception of voice signals in these two cases falls beyond the scope of the book and are covered under other CCSDS protocols.

Validation of specific applications/use-cases listed in the voice and audio communications book in Section 3, 4 and 6 has been done. The sections 5 and 7 are also used by NASA, CNSA and RFSA.

## 1.3 APPLICABILITY

The voice and audio communications book is applicable to voice applications in spaceflight as listed in 5 cases of the book. This includes all use cases and technical specifications as listed in Sections 3 to 7 of the voice and audio communications book.

## 1.4 RATIONALE

The CCSDS Procedures Manual states that for a Recommendation to become a Blue Book, the standard must be tested in an operational manner. The following requirements for an implementation exercise were excerpted from reference [1]:

“At least two independent and interoperable prototypes or implementations

must have been developed and demonstrated in an operationally relevant

environment, either real or simulated.”

This document outlines the voice and audio communications Working Group’s approach to meeting this requirement for the voice and audio communications book.

## 1.5 DOCUMENT STRUCTURE

Section 2 of this document provides a summary and conclusions from validation and testing to date.

Section 3 outlines validation and test goals.

Section 4 provides an overview of what was validated and tested.

Section 5 provides greater detail for each of the scenarios.

Section 6 documents the results.

# SUMMARY CONCLUSIONS/RECOMMENDATION

Current systems onboard the ISS have implemented the protocols listed in the voice and audio communications book for voice communications. Voice or voice embedded in the video being acquired and transmitted from the ISS, regardless of which agency’s cameras, microphones or headsets are acquiring it, is being distributed as required to every space agency participating in ISS activities and to the public through the media using G.728, G.711voice compression or AAC for internet applications . Also telephones or microphones connected via telephone lines to a MCC are used for audio communications between the crew of the ISS and the general public. CNSA uses G.729 for the S/G voice loops and G.711for ground communications.

Based on the current systems being complaint with the voice and audio communications book the voice and audio communications Working Group recommends this book be promoted to a Blue Book CCSDS Recommended Standard.

# V&A VALIDATION AND TEST GOALS

The goal of the validation is twofold:

1. Demonstrate that current International Space Station (ISS), spacecrafts like Soyuz capsules or Dragon voice systems are in compliance with the voice and audio communications book for several of the applications/use-cases.
2. Demonstrate that the current ground segment between different MCCs and between an MCC and a external facility is compliance with the book requirements.

# V&A VALIDATION AND TEST OVERVIEW

Most of the standards in this book have been adopted for the voice systems onboard the ISS and all the MCC over NASA, RFSA, JAXA, CNSA, ESA, CNES and DLR. These space agencies operations are providing a daily proof of concept and operation using the standards listed. This is not coincidental as members of the voice and audio communications working group have been involved in the development of these systems. These systems are considered to be a successful implementation of this book as they are considered acceptable for their respective application by the end users. The voice and audio communications book Section 2 states the voice quality of a system is not measured by the application of the book, but rather by the users of the system. That is, it is considered a success if the end user finds the quality to be acceptable for their purpose (QoE or QX). The fact that the voice system listed in the book are used in a daily basis operation, between the space agencies as with external facilities are well. Based on that measure of success, each of the applications listed in Sections 3 to7 are successful.

## 4.1 Summary of Tests

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Test  | Application | Encoding | Spacecraft | Destination |
| 1 | Voice communications inside of a MCC | G.711, VOIP | N/A | Various, depending on how many buildings are the MCC. |
| 2 | Voice communications between MCCs | G.711, VoIP | N/A | NASA, ESA, RSA, JAXA, DLR, CNES, ASI. |
| 3 | Voice communications between a MCCs and external facilities | G.711, VoIP, telephone lines  | ISS  | NASA, ESA, RSA, DLR, CNES, ASI, JAXA, external |
| 4 | Public Affairs | G.711, VoIP, telephone lines, satellite links. | ISS / Soyuz | NASA, ESA, RSA, DLR, ASI, CNES, JAXA, external |
| 5 | Space to ground voice systems | G.711 / G.728 / G.729 | ISS / Soyuz / Zhengzhou | NASA, JAXA, RSA, ESA, CNES, DLR, CNSA, Commercial Crew |
| 6 | Emergency voice communications | G.728 / UHF /G.729 | ISS / Soyuz / Zhengzhou | NASA, RSA, CNSA, Commercial Crew |
| 7 | Rendezvous, proximity and docking communications | G.728 / UHF / VHF | ISS / Soyuz | NASA, RSA, CNSA, Commercial Crew |
| 8 | Search and rescue voice communications | UHF / VHF | Soyuz | RSA, other entities |

# VALIDATION PLAN DETAILS

Note: the voice and audio communications book is clear that this is not a quality standard. In Section 2, Overview, of the book states quality is based on the requirements of the end-user and they will have to work in conjunction with system engineers to ensure adequate audio and voice quality for their application (QoE or QX).

## 5.1 Test #1 –VOICE COMMUNICATIONS INSIDE OF A MCC

### 5.1.1 SCENARIO

Perform R/T (realtime )Voice communications and audio files playback using the local voice system, including all kind of keyset types, voice loops, voice formats and recording devices (Voice and Audio communications book 2.1.2, 2.1.3, 2.1.4, 2.2, 2.3, 2.3.1, 2.3.2, 2.3.2.1, 2.3.2.2, 2.5, 3.2, 3.3).

The connectivity for the keysets (VoIP or T1/E1) runs through the MCC backbone to the voice matrix or voice switch, then through internal network back/from inside of one control room or to others control rooms inside of the same Building or distributed to / from different buildings.

The playback of the voice loops can be done from the keyset itself or from the central voice recorder.

The Voice format change is coordinated with the planning and operations team. Different voice formats are applied for mission or operations mode, testing and simulations mode.

Different voice loops are selected inside of the different voice format according to the current operations mode.

### 5.1.2 RESULTS

Keysets, voice loops, voice playbacks and voice formats are used on a regular basis for voice communications. They use established network protocols for communication. The voice is being encoded as G.711. Variable voice formats and voice loops are employed, depending upon the current activity of the MCC (mission or OPS, Test and simulations). It is common to have simultaneous activities in different flight control rooms and support rooms inside of a MCC. Ground controllers routinely communicate with each other in different flight control and support rooms or buildings inside a MCC.

## 5.2 TEST #2 VOICE COMMUNICATIONS BETWEEN MCCs

### 5.2.1 SCENARIO

The voice communications between MCCs is done normally using T1/E1 interfaces or VOIP, the most common technology to connect the centers is using MPLS networks or other dedicated lines (Voice and Audio communications book 3.2.1, 3.3, 3.3.22, 3.4, 3.5, 3.5.x.x).

Participating space agencies are NASA, RSA, ESA, DLR, CNES and JAXA.

### 5.2.2 RESULTS

The ISS ground segment has a distributed network based on MPLS network technology connecting all the User Space Operations centers across Europe, USA, Japan and Russia as well.

The common interfaces for the voice system are T1 (USA, Japan) and E1 (Europe and Russia). The codec used is G.711. Signaling is mandatory for the S/G loops used by NASA (G.728 and G.711).

Channelization and voice formats definitions are an extremely important part of the design and operational usage of the voice communications.

All the voice loops and voice formats are quite well defined, but they are also dynamic and always a coordination effort is needed to change voice loops inside a format.

Examples of common voice formats in Europe are the Columbus Operations (With JSC and Marshall), the ATV Operations (including CNES as well), the JMST Format (Joint Multi-Segment Training. Including the European Astronaut Center), the BCC (Backup control center) format with Marshall, LSOS format and the European Simulation format among others.

Different kinds of keysets are used in different agencies, but all of them have the PTT function.

Recording and playback functionalities are implemented at NASA, DLR, ESA, CNES and RSA.

Voice systems are used with the different voice format mentioned above for the corresponding operational scenarios in an everyday basis into the ISS project.

## 5.3 TEST #3 VOICE COMMUNICATIONS BETWEEN MCCs AND EXTERNAL FACILITIES

### 5.3.1 SCENARIO

MCC and research institutions or TV stations (Voice and Audio communications book 3.3.x, 3.4, 3.5.x, 3.6, 3.7, 3.7.x, 4).

Participating space agencies are NASA, RSA, ESA, DLR, CNES and JAXA and external entities.

### 5.3.2 RESULTS

There are different scenarios here. The first one is connecting an external facility having a different voice system or a telephone line (POT) connected to the voice system of the MCCs using a POT or the public internet. Here a previous coordination between the facilities, defining phone numbers and voice loops is mandatory. The external facility is normally patches to an operational loop, using one of the access mentioned above.

This kind of configuration is commonly used by Universities or Research Institution working with experiments on board of the ISS.

## 5.4 TEST #4 PUBLIC AFFAIRS

### 5.4.1 SCENARIO

Use of voice Public Affairs commonly combined with video (Voice and Audio communications book 3.3.1, 3.7, 3.7.x, 4).

Participating space agencies are NASA, RSA, ESA, CNES, DLR and JAXA.

### 5.4.2 RESULTS

This second case of communications between an MCC and an external place is more complicated but used also quite often for Public Relation events. Here is the coordination effort a lot bigger because the people involved are not familiar with space communications and have not knowledge about etiquette and protocol. Crew time is also required and need to be well planned in advance.

A common issue is an open microphone generating quindars in the S/G loop or events that have communication in both directions where lip sync is required.

In many of such events non standards satellite links are used and every time the voice device used is different (e.g. black phone, Microphone, Headset, external Keyset) and the connection as well (phone call, satellite link, terrestrial link, etc).

A quite big problem is the moderators not knowing the etiquette and protocol. That causes a lot of cross-talking and an extra coordination effort especially at the beginning of the event. Several times an open micro introduces noises or background music in the loops that need to be filtered or eliminated.

This kind of configuration is used in a weekly basis, but because of all the issues mentioned above is every time a challenge for the voice and video teams.

## 5.5 TEST #5 SPACE TO GROUND VOICE SYSTEMS

### 5.5.1 SCENARIO

Space to ground communications using NASA or RSA channels (Voice and Audio communications book 4.1, 4.2, 4.2.1, 4.2.2, 4.2.3, 4.4, 4.4.x). On the ISS are two S/G channels using a legacy technology (1 and 2) and two using the G.711 (3 and 4). RSA use normally the same voice channels, but they have also they own channels.

Participating space agencies are NASA, DLR, ESA, CNES, RSA and JAXA. CNSA have his own communications channels

### 5.5.2 RESULTS

For the S/G communications the 4 voice loops of NASA are extended to the other agencies, like ESA, DLR or CNES. For special cases like in the previous 2 ones, it is common to extend the voice loops to externals facilities as well.

For docking operations and in other occasions the 2 RSA loops are used and extended to the other Space Agencies.

## 5.6 TEST #6 EMERGENCY VOICE COMMUNICATIONS

### 5.6.1 SCENARIO

Emergency communications with ISS and Soyuz capsule (Voice and Audio communications book 5.2, 5.2.x). These emergency communications are tested 1 time a month for the crew on board and on the ground. They are also exercised during simulations in a regular basis.

Participating space agencies are NASA, ESA, DLR and RSA

### 5.6.2 RESULTS

There are regular emergency simulations where these systems are tested; participating agencies are ESA, DLR, CNES and NASA. Only NASA and RSA use the voice emergency communications.

## 5.7 TEST #7 RENDEZVOUS; PROXIMITY AND DOCKING COMMUNICATIONS

### 5.7.1 SCENARIO

Rendezvous of Soyuz, ATV, HTVC, Space X and other vehicles (Voice and Audio communications book 6.2, 6.2.x).

Participating space agencies are NASA, RSA, CNES and JAXA.

### RESULTS

For every docking or manned vehicles these systems are used. The lead Agency is Roscosmos, other agencies participating are CNES, DLR, NASA and ESA.

For commercial crew, only NASA and the corresponding companies are participating.

CSNA uses their own systems.

## 5.8 TEST #8 SEARCH AND RESCUE VOICE COMMUNICATIONS

### 5.8.1 SCENARIO

Voice and Audio communications book 7.1 and 7.2. Participating space agencies are NASA and RSA.

### 5.8.2 RESULTS

Since the only vehicle transporting humans into space now is Soyuz, all these communications are led by Roscosmos. There other institutions participating as well.

# SCENARIO RESULT DETAILS

## 6.1 SCENARIO #1 V&A inside of a MCC

**Summary**

|  |  |  |
| --- | --- | --- |
| 1 | Report Date |  |
| 2 | Program Under Test | CCSDS 706.2.1-Y-0 |
| 3 | Test Case Number | #1 V&A inside of a MCC |
| 4 | Agencies Participating | NASA, RSA, ESA, JAXA, DLR, CNES |
| 5 | Agency Responsible for Generating Audio  | NASA, RSA, ESA, DLR, CNES, JAXA |
| 6 | Producing Test Engineer |  |
| 7 | Agency Responsible for Receiving Audio | NASA, RSA, ESA, JAXA, DLR, CNES |
| 8 | Receiving Test Engineer |  |
| 9 | Spacecraft | N/A |
| 10 | Results (Pass, Partial Pass, Fail)  | Pass |
| 11 | Variances from Expected Result: | None |
| 12 | Comments | Currently being done between ISS crewmembers and ground participants |

**Details**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Agency | Codec | communication | Applicable Pics  |
| 1 | NASA | G.711 | E1/T1, VOIP | A5- 1,2,3, A6-3,4,5,6,7,8,9,10,11,12,13,14,15,16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,13,14,15,16,17, A-10 1,2,3,4 |
| 2 | DLR | G.711 | E1/T1, VOIP | A5- 1,2,3, A6-3,4,5,6,7,8,9,10,11,12,13,14,15,16,17, A7-1,2,3, A8-1,2,4,5,6,7,8,11,14,15,16,17, A-10 1,2,3,4 |
| 3 | RSA | G.711 | E1/T1 | A5- 1,2,3, A6-3,4,5,6,7,8,9,10,11,12,13,14,15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,13,14,15, A-10 1,2,3,4 |
| 4 | CNES | G.711/G.728 | E1 | A5- 1,2,3, A6-3,4,5,6,7,9,10,12,13,15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,13,14,15, A-10 1,2,3,4 |
| 5 | ESA (EAC) | G.711 | E1 | A5- 1,2,3, A6-3,4,5,6,7,8,9,10,11,12,13,14,15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,14,15, A-10 1,2,3,4 |
| 6 | JAXA | G.711/G.728 | E1/T1 | A5- 1,2,3, A6-3,4,5,6,7,8,9,10,11,12,13,14,15,16,17, A7-1,2,3, A8-1,2,3,4,6,7,8,11,13,14,15,16,17, A-10 1,2,3,4 |
| 7 | CNSA | G.711 | E1/T1, VOIP | A5- 1,2,3, A6-3,4,5,6,7,8,9,10,11,12,13,14,15,16,17, A7-1,2,3, A8-1,2,3,4,6,7,8,9,1011,12,14,15,16,17, A-10 1,2,3,4 |

## 6.2 SCENARIO #2 V&A between different MCCS

**Summary**

|  |  |  |
| --- | --- | --- |
| 1 | Report Date |  |
| 2 | Program Under Test | CCSDS 706.2.1-Y-0 |
| 3 | Test Case Number | #2 V&A between different MCCS |
| 4 | Agencies Participating | NASA, RSA, ESA, JAXA, CNES, DLR |
| 5 | Agency Responsible for Generating Audio  | NASA, RSA, ESA, JAXA, CNES, DLR |
| 6 | Producing Test Engineer |  |
| 7 | Agency Responsible for Receiving Audio | NASA, RSA, ESA, JAXA, CNES, DLR |
| 8 | Receiving Test Engineer |  |
| 9 | Spacecraft | ISS |
| 10 | Results (Pass, Partial Pass, Fail)  | Pass |
| 11 | Variances from Expected Result: | None |
| 12 | Comments | Currently being done between ISS crewmembers and ground participants |

**Details**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Agency | Codec | communication | Applicable Pics  |
| 1 | NASA | G.711 | E1/T1, VOIP | A5- 1,2,3, A6-1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,13,14, 15,16,17, A9- 1, A-10 1,2,3,4 |
| 2 | DLR | G.711 | E1/T1 | A5- 1,2,3, A6-1,2, 3,4,5,6,7,8,9,10,11,12,13,14 ,15,16,17, A7-1,2,3, A8-1,2,4,5,6,7,8,11,14,15, 16,17, A9- 1, A-10 1,2,3,4 |
| 3 | RSA | G.711 | E1/T1 | A5- 1,2,3, A6-1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,13,14,15, A9- 1, A-10 1,2,3,4 |
| 4 | CNES | G.711 | E1 | A5- 1,2,3, A6-1,2,3,4,5,6,7,9,10,12,13,15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,13,14,15, A9- 1, A-10 1,2,3,4 |
| 5 | ESA (EAC) | G.711 | E1 | A5- 1,2,3, A6-1,2,3,4,5,6,7,8,9,10,11,12,13,14 ,15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,14,15, A9- 1, A-10 1,2,3,4 |
| 6 | JAXA | G.711 | E1/T1 | A5- 1,2,3, A6-1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17, A7-1,2,3, A8-1,2,3,4,6,7,8,11,13,14,15,16,17, A9- 1 A-10 1,2,3,4 |
| 7 | CNSA | G.711 | E1/T1, VOIP | A5- 1,2,3, A6-1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17, A7-1,2,3, A8-1,2,3,4,6,7,8,9,1011,12,14,15, 16,17, A9- 1, A-10 1,2,3,4 |

## 6.3 SCENARIO #3 V&A between an MCC and An External facility

**Summary**

|  |  |  |
| --- | --- | --- |
| 1 | Report Date |  |
| 2 | Program Under Test | CCSDS 706.2.1-Y-0 |
| 3 | Test Case Number | #3 V&A between an MCC and An External facility |
| 4 | Agencies Participating | NASA, RSA, ESA, JAXA, DLR, CNES |
| 5 | Agency Responsible for Generating Audio  | NASA, RSA, ESA,DLR, JAXA, CNES, external entities |
| 6 | Producing Test Engineer |  |
| 7 | Agency Responsible for Receiving Audio | NASA, RSA, DLR, JAXA, ESA, CNES, external entities |
| 8 | Receiving Test Engineer |  |
| 9 | Spacecraft | ISS |
| 10 | Results (Pass, Partial Pass, Fail)  | Pass |
| 11 | Variances from Expected Result: | None |
| 12 | Comments | Routine daily ISS Operations |

**Details**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Agency | Codec | communication | Applicable Pics  |
| 1 | NASA | G.711 | E1/T1, VOIP | A5- 3,4 A6-2,3,4,5,6,7,8,9,10,12,13,15,16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,14,15,16,17, A9- 2, A-10 1,2,3,4 |
| 2 | DLR | G.711 | E1/T1 | A5- 3,4, A6-2,3,4,5,6,7,8,9,10,12,13,14,16,17, A7-1,2,3, A8-1,2,4,5,6,7,8,11,14,15,16,17, A9- 2, A-10 1,2,3,4 |
| 3 | RSA | G.711 | E1/T1 | A5- 3,4 A6-2,3,4,5,6,7,8,9,10,12,13,14,15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,13,14,15, A9- 2, A-10 1,2,3,4 |
| 4 | CNES | G.711 | E1 | A5- 4 A6-3,4,5,6,7,9,10,12,13,15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,13,14,15, A9- 2, A-10 1,2,3,4 |
| 5 | ESA (EAC) | G.711 | E1 | A5- 4, A6-3,4,5,6,7,8,9,10,11,12,13,14,15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,14,15, A9- 2, A-10 1,2,3,4 |
| 6 | JAXA | G.711 | E1/T1 | A5- 4, A6-3,4,5,6,7,8,9,10,11,12,13,14,15,16,17, A7-1,2,3, A8-1,2,3,4,6,7,8,11,13,14,15,16,17, A9- 2 A-10 1,2,3,4 |
| 7 | CNSA | G.711 | E1/T1, VOIP | A5- 3,4, A6-3,4,5,6,7,8,9,10,11,12,13,14,15,16,17, A7-1,2,3, A8-1,2,3,4,6,7,8,9,1011,12,14,15,16,17, A9- 2, A-10 1,2,3,4 |

## 6.4 SCENARIO #4 PUBLIC AFFAIRS

**Summary**

|  |  |  |
| --- | --- | --- |
| 1 | Report Date |  |
| 2 | Program Under Test | CCSDS 706.2.1-Y-0 |
| 3 | Test Case Number | #4 PUBLIC AFFAIRS |
| 4 | Agencies Participating | NASA, RSA, ESA, DLR, CNES, ASI, JAXA |
| 5 | Agency Responsible for Generating Audio  | NASA, RSA, DLR, ESA, JAXA, CNES, ASI, external entities |
| 6 | Producing Test Engineer |  |
| 7 | Agency Responsible for Receiving Audio | NASA, RSA, DLR, ESA, CNES, ASI, JAXA external entities |
| 8 | Receiving Test Engineer |  |
| 9 | Spacecraft | ISS |
| 10 | Results (Pass, Partial Pass, Fail)  | Pass |
| 11 | Variances from Expected Result: | None |
| 12 | Comments | Routine daily ISS Operations |

**Details**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Agency | Codec | communication | Applicable Pics  |
| 1 | NASA | G.711 | E1/T1, VOIP. POTS | A5- 3,4 A6-2,5,12,13,16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,14,15, A9- 2, A-10 1,2,3,4 |
| 2 | DLR | G.711 | E1/T1, POTS | A5- 3,4 A6-2,5,12,13,16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,14,15, A9- 2, A-10 1,2,3,4 |
| 3 | RSA | G.711 | E1/T1, POTS | A5- 3,4 A6-2,5,12,13,16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,14,15, A9- 2, A-10 1,2,3,4 |
| 4 | CNES | G.711 | E1, POTS | A5- 3,4 A6-2,5,12,13,16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,14,15, A9- 2, A-10 1,2,3,4 |
| 5 | ESA (EAC) | G.711 | E1, POTS | A5- 3,4 A6-2,5,12,13,16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,14,15, A9- 2, A-10 1,2,3,4 |
| 6 | JAXA | G.711 | E1/T1, POTS | A5- 3,4 A6-2,5,12,13,16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,14,15, A9- 2, A-10 1,2,3,4 |
| 7 | CNSA | G.711 | E1/T1, VOIP, POTS | A5- 3,4 A6-2,5,12,13,16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,14,15, A9- 2, A-10 1,2,3,4 |

## 6.5 SCENARIO #5 V&a Space to Ground communications

**Summary**

|  |  |  |
| --- | --- | --- |
| 1 | Report Date |  |
| 2 | Program Under Test | CCSDS 706.2.1-Y-0 |
| 3 | Test Case Number | #5 S/G communications |
| 4 | Agencies Participating | NASA, RSA, ESA, JAXA, DLR, CNES |
| 5 | Agency Responsible for Generating Audio  | NASA, RSA, ESA, JAXA |
| 6 | Producing Test Engineer |  |
| 7 | Agency Responsible for Receiving Audio | NASA, RSA, ESA, JAXA, DLR, CNES, ASI |
| 8 | Receiving Test Engineer |  |
| 9 | Spacecraft | ISS |
| 10 | Results (Pass, Partial Pass, Fail)  | Pass |
| 11 | Variances from Expected Result: | None |
| 12 | Comments | Currently being done between ISS crewmembers and ground participants |

**Details**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Agency | Codec | communication | Applicable Pics  |
| 1 | NASA | G.711 /G.728 | E1/T1, VOIP /VHF | A5- 1,2,5 A6-1,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17 A7-1,2,3 A8-1,2,3,4,5,6,11,13,14,15, A9- 1,3, A-10 1,2,3,4 |
| 2 | DLR | G.711 | E1/T1 | A5- 1,2 A6-1,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17 A7-1,2,3 A8-1,2,3,4,5,6,7,8,11,14,15 A9- 1, A-10 1,2,3,4 |
| 3 | RSA | G.711 /G.728 | E1/T1 /VHF | A5- 1,2,5 A6-1,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17 A7-1,2,3 A8-1,2,3,4,5,6,7,8,11,13,14,15, A9- 1,3, A-10 1,2,3,4 |
| 4 | CNES | G.711 | E1 | A5- 1,2 A6-1,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17 A7-1,2,3 A8-1,2,3,4,5,6,7,8,11,14,15 A9- 1, A-10 1,2,3,4 |
| 5 | CNSA | G.729 | E1/T1, VOIP /VHF | A5- 1,2,5 A6-1,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17 A7-1,2,3 A8-1,2,3,4,5,6,7,8,11,12 14,15,16,17, A9- 1,3, A-10 1,2,3,4 |

## 6.6 SCENARIO #6 V&a emergency communications

**Summary**

|  |  |  |
| --- | --- | --- |
| 1 | Report Date |  |
| 2 | Program Under Test | CCSDS 706.2.1-Y-0 |
| 3 | Test Case Number | #6 V&A Emergency Communications |
| 4 | Agencies Participating | NASA, RSA, DLR, CNES, ESA |
| 5 | Agency Responsible for Generating Audio  | NASA, RSA |
| 6 | Producing Test Engineer |  |
| 7 | Agency Responsible for Receiving Audio | NASA, DLR, ESA, CNES, RSA |
| 8 | Receiving Test Engineer |  |
| 9 | Spacecraft | ISS |
| 10 | Results (Pass, Partial Pass, Fail)  | Pass |
| 11 | Variances from Expected Result: | None |
| 12 | Comments | Done in simulations in a regular basis |

**Details**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Agency | Codec | communication | Applicable Pics  |
| 1 | NASA | G.711 | E1/T1, VOIP | A5- 1,2,3,4 A6-1,2,3,4,5,6,7,11,12,13,16,17, A7-1,2,3, A8-1,4,5,6,7,8,13,14, A9- 4, A-10 1,2,3,4 |
| 2 | DLR | G.711 | E1/T1 | A5- 1,2,3,4 A6-1,2,3,4,5,6,7,11,12,13,16,17, A7-1,2,3, A8-1,4,5,6,7,8,13,14, A9- 4, A-10 1,2,3,4 |
| 3 | RSA | G.711 | E1/T1 | A5- 1,2,3,4 A6-1,2,3,4,5,6,7,11,12,13,16,17, A7-1,2,3, A8-1,4,5,6,7,8,13,14, A9- 4, A-10 1,2,3,4 |
| 4 | CNES | G.711 | E1 | A5- 1,2,3,4 A6-1,2,3,4,5,6,7,11,12,13,16,17, A7-1,2,3, A8-1,4,5,6,7,8,13,14, A9- 4, A-10 1,2,3,4 |
| 5 | ESA (EAC) | G.711 | E1 | A5- 1,2,3,4 A6-1,2,3,4,5,6,7,11,12,13,16,17, A7-1,2,3, A8-1,4,5,6,7,8,13,14, A9- 4, A-10 1,2,3,4 |
| 6 | JAXA | G.711 | E1/T1 | A5- 1,2,3,4 A6-1,2,3,4,5,6,7,11,12,13,16,17, A7-1,2,3, A8-1,4,5,6,7,8,13,14, A9- 4, A-10 1,2,3,4 |
| 7 | CNSA | G.711 | E1/T1, VOIP | A5- 1,2,3,4 A6-1,2,3,4,5,6,7,11,12,13,16,17, A7-1,2,3, A8-1,4,5,6,7,8,13,14, A9- 4, A-10 1,2,3,4 |

## 6.7 SCENARIO #7 Rendevoux, proximity and docking

**Summary**

|  |  |  |
| --- | --- | --- |
| 1 | Report Date |  |
| 2 | Program Under Test | CCSDS 706.2.1-Y-0 |
| 3 | Test Case Number | #7 Rendevoux, proximity and docking |
| 4 | Agencies Participating | NASA, RSA, ESA, JAXA, DLR, CNES |
| 5 | Agency Responsible for Generating Audio  | NASA, RSA, ESA, JAXA |
| 6 | Producing Test Engineer |  |
| 7 | Agency Responsible for Receiving Audio | NASA, RSA, ESA, JAXA, CNES, DLR |
| 8 | Receiving Test Engineer |  |
| 9 | Spacecraft | ISS |
| 10 | Results (Pass, Partial Pass, Fail)  | Pass |
| 11 | Variances from Expected Result: | None |
| 12 | Comments | Currently being done between ISS crewmembers and ground participants |

**Details**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Agency | Codec | communication | Applicable Pics  |
| 1 | NASA | G.711 | E1/T1, VOIP /VHF | A5- 1,2,3, A6-1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17, A7-1,2,3, A8-1,2,3,4,5,6,7,8,11,13,14, 15,16,17, A9-1, 5, A-10 1,2,3,4 |
| 2 | DLR | G.711 | E1/T1 | A5- 1,2,3, A6-1,2, 3,4,5,6,7,8,9,10,11,12,13,14 ,15,16,17, A7-1,2,3, A8-1,2,4,5,6,7,8,11,14,15, 16,17, A9- 1, A-10 1,2,3,4 |
| 3 | RSA | G.711 | E1/T1/VHF | A5- 1,2,3, A6-1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,13,14,15, A9-1, 5, A-10 1,2,3,4 |
| 4 | CNES | G.711 | E1 | A5- 1,2,3, A6-1,2,3,4,5,6,7,9,10,12,13,15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,13,14,15, A9- 1, A-10 1,2,3,4 |
| 5 | ESA (EAC) | G.711 | E1 | A5- 1,2,3, A6-1,2,3,4,5,6,7,8,9,10,11,12,13,14 ,15,16,17, A7-1,2,3, A8-1,2,3,4,6,11,13,14,15, A9- 1, A-10 1,2,3,4 |
| 6 | JAXA | G.711 | E1/T1 | A5- 1,2,3, A6-1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17, A7-1,2,3, A8-1,2,3,4,6,7,8,11,13,14,15,16,17, A9- 1 A-10 1,2,3,4 |
| 7 | CNSA | G.711 | E1/T1, VOIP /VHF | A5- 1,2,3, A6-1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, 16,17, A7-1,2,3, A8-1,2,3,4,6,7,8,9,1011,12,14,15, 16,17, A9- 1,5, A-10 1,2,3,4 |

## 6.8 SCENARIO #8 V&A search and rescue communications

**Summary**

|  |  |  |
| --- | --- | --- |
| 1 | Report Date |  |
| 2 | Program Under Test | CCSDS 706.2.1-Y-0 |
| 3 | Test Case Number | #8 V&A search and rescue communications |
| 4 | Agencies Participating | NASA, RSA |
| 5 | Agency Responsible for Generating Audio  | NASA, RSA |
| 6 | Producing Test Engineer |  |
| 7 | Agency Responsible for Receiving Audio | NASA, RSA, other entities /CNSA |
| 8 | Receiving Test Engineer |  |
| 9 | Spacecraft | ISS |
| 10 | Results (Pass, Partial Pass, Fail)  | Pass |
| 11 | Variances from Expected Result: | None |
| 12 | Comments | Currently being done between ISS crewmembers and ground participants |

**Details**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Agency | Communication | Applicable Pics  |
| 1 | RSA | E1/T1, VOIP /VHF /POTS | A5- 1,2,3,4 A6-2,3,4,12,13,14,15,16 A7-1,2,3, A8-18, A9-6 A-10 1,2,3,4 |
| 2 | NASA | E1/T1, VOIP /VHF /POTS | A5- 1,2,3,4 A6-2,3,4,12,13,14,15,16 A7-1,2,3, A8-18, A9-6 A-10 1,2,3,4 |
| 3 | CNSA | E1/T1, VOIP /VHF /POTS | A5- 1,2,3,4 A6-2,3,4,12,13,14,15,16 A7-1,2,3, A8-18, A9-6 A-10 1,2,3,4 |