International Civil Aviation Organization

Twenty Eighth Meeting of the Communications, Navigation and Surveillance Sub-group (CNS SG/28)

Bangkok, Thailand, 1 - 5 July 2024

Agenda Item 5: Aeronautical Mobile Communications Service and Aeronautical electromagnetic spectrum utilisation

SPACE-BASED VERY HIGH FREQUENCY (VHF) COMMUNICATION SERVICES

(Presented by Singapore)

SUMMARY

This paper is to update the meeting on the progress of the technical and regulatory studies of space-based VHF communications (voice and data) in the frequency band 117.975-137 MHz.

1. INTRODUCTION

1.1 Space-based VHF communication is a concept in which aircraft operating in remote regions and oceanic areas provide communications from the aircraft to air traffic control (ATC) via satellite. This concept, when implemented, is expected to support air traffic management and flight operations in oceanic and remote airspace and will complement current aviation use of satellite-based navigation and surveillance technologies.

1.2 While currently there are other long-range communication systems, such as HF and SATCOM, available to facilitate communications between aircraft and ATC in remote and oceanic airspace, the performance of these current systems are not adequate to safely support close aircraft-to-aircraft separation in a similar fashion as to what is being applied in dense airspace where terrestrial VHF communications infrastructure is predominant. Therefore, this leads to constraints in airspace capacity and efficiency in oceanic and remote areas, where it is not possible nor practical to deploy VHF terrestrial infrastructures.

1.3 With the space-based VHF communication concept, it will be just like another VHF station in the sky, but with a larger footprint than terrestrial stations.

2. **DISCUSSION**Space-based VHF communications is envisaged to extent the coverage of the following aeronautical VHF communication services using satellite as a platform:

- Voice is the most critical VHF communication application in terms of safety and dependability.
- Datalink is commonly used for ACARS and VDL Mode 2 applications.

2.2 The following objectives were considered in the design of the space-based VHF system:

- No change to aircraft avionic equipment.

- No change to terrestrial base stations configuration located in flight information regions (FIRs) which do not make use of the space-based VHF service.
- No or minimal change to terrestrial base stations configuration in FIRs with space-based VHF service.
- No or minimal change to operational aspects for pilots and controllers.

International Telecommunication Union ("ITU")

2.3 Space-based VHF frequency allocation was an Agenda Item 1.7 for the World Radiocommunication Conference 2023 ("WRC-23").

2.4 In December 2023, WRC-23 approved the use of the frequency band 117.975-137 MHz to be allocated for aeronautical mobile-satellite (R) service ("AMS(R)S"), enabling satellite-aircraft communications in the VHF frequency spectrum.

Future VHF Subgroup ("FVSG")

2.5 In October 2020, the formation of Future VHF Subgroup ("FVSG") was approved under the Data Communications Infrastructure Working Group of the Communications Panel ("CP-DCIWG") to facilitate global/regional adoption and implementation of space-based VHF communications.

2.6 A new job card was created and approved by Air Navigation Commission (ANC) in March 2023 with defined timeline to review the ICAO provisions, such as Annex 10 Volume 3, and provide necessary technical inputs, materials to support and guide the implementation of new aeronautical satellite VHF communication technologies. The latest meeting report of FVSG is attached below.

FVSG/7 Meeting Report (Appendix A)	FVSG 7 Meeting Report_final.docx

Frequency Spectrum Management Panel ("FSMP")

2.7 A space-based VHF Correspondence Group (CG) was also setup in December 2023, to develop frequency planning and channel allocation/coordination processes for space-based VHF operations. More details can be found in the attachment below.

Space-based VHF Correspondence Group (Appendix B)	FVSG7_IP02-satellite_ based_CG.pdf

Proof-of-Concept (PoC) Demonstration

2.8 Currently, there are two companies working in parallel to the launch prototype satellites with VHF payload for PoC demonstrations between 2023 and 2025. The companies are Skykraft, an Australian space services company and Startical, a joint venture of Enaire and Indra.

2.9 Both companies are planning to launch a constellation of satellites specifically designed for ATM to provide space-based VHF communications as well as ADS-B surveillance services with global coverage.

2.10 To conduct the PoC demonstration, there will be a need for ICAO regional office to assign appropriate VHF frequencies so that verification tests could take place.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained within this paper;

b) support the ICAO activities on space-based VHF at the FVSG and FSMP;

c) support the frequency assignments for proof-of-concept demonstration when the need arises; and

d) discuss any relevant matter as appropriate.

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International Civil Aviation Organization

FVSG/7-WP/02
02/24

WORKING PAPER

Data Communications Infrastructure Working Group (DCIWG)

Project Team – Terrestrial (PT-T)
Future VHF Sub-Group Meeting 7
19 Feb 2024

Agenda Item 1 of FVSG: FVSG/7 Meeting Report

Future VHF Sub-Group (FVSG) 7 Meeting Report

(Submitted by John Chong, Rapporteur)

SUMMARY

This is the meeting report for the 7th meeting of the Future VHF Sub-Group (FVSG) held in Montreal from 19 to 20 Feb 2024.

Agenda Item	Title	Discussion Points	FVSG/7 Meeting Summary of Discussions
1	**FVSG Working Programme**		
1.1	Work Programme	Work Programme 2024 to be approved by FVSG	The meeting discussed WP01. Appendix A shows the FVSG Work Programme agreed by the 7th FVSG meeting.
1.2	Meeting Arrangements	Suggested 3 times yearly: 1. 2 times to hold back-to-back with FSMP WG meetings 2. 3rd one to hold back-to-back with DCIWG meetings	The meeting decided on the following, to facilitate preparation for submission of Annex 10 Vol 3 PfAs to DCIWG in Jun 2024: 1. Virtual meetings to be held on 14 March and 26 March; 2. Physical meeting to be held from 9 to 12 April in Bangkok or Singapore.
1.3	Job-Card of FVSG	To update job-card following approval of	The meeting drafted proposed amendments to the FVSG job card. This version will be further developed in the

Agenda Item	Title	Discussion Points	FVSG/7 Meeting Summary of Discussions
		space-to-earth VHF spectrum by WRC-23	April 2024 FVSG meeting, before onward submission to PT-T and DCIWG in June 2024.  FVSG Job Card Text R2.docx
1.4	GANP Change Request to include space-based VHF	Raza to update status of GANP change request.	The meeting was updated that space-based VHF was submitted to include into the GANP at GANP/SG. The formal approval will be at the next ICAO Assembly in 2026.
2	**Review of VHF SARPs and Guidance Materials**		
2.1	Annex 10 Volume 3	To complete Annex 10 Volume 3 SARPs PfAs by DCIWG meeting in 2024.	The meeting discussed WP02, further refined and agreed on proposed amendments to Annex 10 Volume 3 SARPs.  FVSG WP Annex 10 Vol 3 SAPRS Update Specifically, the following action items are recorded: ***[AI1] Raza to check within ICAO Secretariat on how to differentiate the L-Band AMS(R)S services (provided by Inmarsat and Iridium) and the space-based VHF AMS(R)S, with specific reference to Annex 10 Volume 3 Part 1 Chapter 4 title.*** ***[AI2] John and Matthew to present proposed changes to Annex 10 Volume 3 Part 1 Chapter 4, to the PT-Sat meeting in March 2024. Raza to confirm a 1-hour virtual slot for discussion.***
2.2	Doc 9925 (Manual on the Aeronautical Mobile Satellite (Route) Service)	To start review.	The meeting agreed that the approach to develop PfAs to Doc 9925 will be discussed after the June 2024 DCIWG meeting.
2.3	Doc 9776 (Manual On VHF Digital Link (VDL) Mode 2)	To start review.	The meeting agreed that the approach to develop PfAs to Doc 9776 will be discussed after the June 2024 DCIWG meeting, including forming an editing group between FVSG and WG-M.
2.4	SARPs Validation Plans and Reports	Industry/ANSPs to present trial progresses and results in support of SARPs validation.	The meeting was briefed on the ANC approval process for SARPs PfAs, including the need to develop (i) validation report and (ii) implementation task list for submission together with the SARPs PfAs.

Agenda Item	Title	Discussion Points	FVSG/7 Meeting Summary of Discussions
			The meeting agreed the following task allocation to speed up the work to develop validation report: ***[AI3] Final Validation Report merging and editing (John, Andrew)*** ***1. Introduction (Henry, Seyed)*** ***a. Background*** ***b. WRC-23 studies to prove interoperability and Technical feasibility*** ***i. Link budgets*** ***ii. Doppler shifts*** ***iii. Scintillation effects*** ***iv. Antenna patterns*** ***2. Technical Concept of the System Operations (Manuel, Matthew)*** ***a. No change in avionics and ground VHF equipment*** ***b. Voice*** ***c. Datalink*** ***3. Specific Validation Plans and Tests*** ***a. Startical (Jose)*** ***b. Skykraft (Craig)*** ***4. Compliance to Annex 10 Vol 3 SARPS (Jose, Manuel, Craig, Matthew)*** ***a. Matrix matching*** ***5. Implementation Task list (John, Manuel, Matthew)***
2.5	ETSI Standard ETSI EN 300 676RTCA / Eurocae Standards	To discuss when is a good point to start review, if required.	The meeting noted the benefits of engaging Eurocae/RTCA to consider evaluating the need to develop standards for space-based VHF. To follow up, ***[AI4] Jose to initiate contact with Eurocae, and start discussions on the process to develop Eurocae/RTCA standards for space-based VHF.***
3	**Space-based VHF Technology Developments**		
3.1	Startical Developments	To share development progress	The meeting noted WP03 on Startical development plan presented by Jose.
3.2	Skykraft Developments	To share development progress	The meeting noted IP03 on Skykraft plans to implement space-based VHF.

Agenda Item	Title	Discussion Points	FVSG/7 Meeting Summary of Discussions
3.3	Others	Placeholder to accommodate other industry involvement in satellite VHF	NIL.
4	**Space-based VHF Operational Matters – Coordination with OPDLWG (ATC, Pilots, Avionics/Airframers)**		
4.1	Avionics	To discuss	The meeting agreed on the importance of engaging OPDLWG early in the SARPs development process. On this note: ***[AI5] Jose/Manuel to follow up with OPDLWG Chair Shelley, to discuss the approach to start engagement with OPDLWG on space-based VHF.***
4.2	Airlines Engineering/Ops	To discuss	
4.3	Flight Crew Training	To discuss	
4.4	Aircraft Operator Operational Approval	To discuss	
5	**Liaison between DCIWG and FSMP – SARPs, Guidance Materials, Coordination with ITU, Radio Regulators and ICAO Regional Offices**		
5.1	Annex 10 Volume 5	FVSG to provide inputs as and when necessary.	The meeting noted IP02 presented by Manuel, specifically that FSMP Sat-VHF Correspondence Group (CG) was set up, and this CG and FVSG could have direct working-level correspondences without going through their respective parent Panels. The meeting also noted that the FVSG job card item on Annex 10 Volume 5 will be taken over by FSMP, and submission of the Annex 10 Volume 5 PfAs will be through FSMP endorsement in 2025.
5.2	Planning Criteria – Doc 9718	FVSG to provide inputs as and when necessary.	The meeting noted that Doc 9718 PfAs will be discussed at FSMP Sat-VHF CG.
5.3	Coordination: ANSPs, State Regulators, Radio Regulators	To discuss	The meeting agreed to remove this sub-Agenda item, given that ITU and ICAO correspondences are facilitated through FSMP.
5.4	Coordination: ICAO Regional Offices	To discuss	The meeting noted that coordination with ICAO Regional Offices will commence after a matured version of the Annex 10 Volume 5 PfAs are developed.
5.5	Coordination: ICAO Panels, e.g. SASP, ATMOPS, FLTOPSP	To discuss	The meeting agreed that coordination to start after PfAs endorsed by DCIWG in June 2024.
5.6	Coordination : RTCA/EUROCAE, AEEC	To discuss	See para. 2.5 above.
6	**Other VHF Technologies**		
6.1	Advanced VDL	Not started	

Agenda Item	Title	Discussion Points	FVSG/7 Meeting Summary of Discussions
6.2	VHF on high altitude platforms		The meeting agreed to remove Agenda Item 6 from the Work Programme.

Appendix A – FVSG Work Programme Agreed at FVSG/7 Meeting in Feb 2024

Agenda Item	Title
1	**FVSG Working Programme**
1.1	Work Programme
1.2	Meeting Arrangements
1.3	Job-Card of FVSG
1.4	GANP Change Request to include space-based VHF
2	**Review of VHF SARPs and Guidance Materials**
2.1	Annex 10 Volume 3
2.2	Doc 9925 (Manual on the Aeronautical Mobile Satellite (Route) Service)
2.3	Doc 9776 (Manual On VHF Digital Link (VDL) Mode 2)
2.4	SARPs Validation Plans and Reports
2.5	ETSI Standard ETSI EN 300 676RTCA / Eurocae Standards
3	**Space-based VHF Technology Developments**
3.1	Startical Developments
3.2	Skykraft Developments
3.3	Others
4	**Space-based VHF Operational Matters – Coordination with OPDLWG (ATC, Pilots, Avionics/Airframers)**
4.1	Avionics
4.2	Airlines Engineering/Ops
4.3	Flight Crew Training
4.4	Aircraft Operator Operational Approval
5	**Liaison between DCIWG and FSMP, and Coordination with other Stakeholders**
5.1	Annex 10 Volume 5
5.2	Planning Criteria – Doc 9718
5.3	Coordination: ICAO Regional Offices
5.4	Coordination: ICAO Panels, e.g. SASP, ATMOPS, FLTOPSP
5.5	Coordination : RTCA/EUROCAE, AEEC

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02/24

WORKING PAPER

Data Communications Infrastructure Working Group (DCIWG)

Project Team – Terrestrial (PT-T)
Future VHF Sub-Group Meeting 7
19 Feb 2024

Agenda Item 5 of FVSG: Liaison between DCIWG and FSMP – SARPs, Guidance Materials, Coordination with ITU, Radio Regulators and ICAO Regional Offices

Space-Based VHF Correspondence Group ToR

(Presented by Manuel Garcia and Mattew Kelly)

SUMMARY

At the World Radio Conference 2023, a new allocation to the aeronautical mobile-satellite (R) service, AMS(R)S, in the frequency band 117.975 - 137 MHz was approved. The new allocation is required to be operated in accordance with international aeronautical standards. The RESOLUTION COM4/2 (WRC-23) was also approved inviting the International Civil Aviation Organization to take into account this Resolution in the course of developing SARPs for the AMS(R)S and planning the AM(R)S and AMS(R)S in the frequency band 117.975-137 MHz.

In this way, it is necessary to develop scenarios for implementation of Space-Based VHF. In addition to this, development of the planning criteria for satellite VHF should also be conducted by the FSMP.

To facilitate these efforts, FSMP/WG17 meeting agreed with the establishment of the Correspondence Group (CG) initially called the Space-Based VHF CG, aiming at first defining its terms of reference for such work, the expected timeframe of the project and potential deliverables.

So, this paper contains a proposed Terms of Reference of the Space-Based VHF Correspondence Group.

Space-Based VHF Correspondence Group
Terms of Reference

Background:

At the World Radio Conference 2023, a new allocation to the aeronautical mobile-satellite (R) service, AMS(R)S, in the frequency band 117.975 - 137 MHz was approved. The RESOLUTION 428 (WRC-23) was also approved inviting the International Civil Aviation Organization to take into account this Resolution in the course of developing SARPs for the VHF AMS(R)S and planning the AM(R)S and AMS(R)S in the frequency band 117.975-137 MHz.

The new VHF AMS(R)S systems are required to be operated in accordance with international aeronautical standards, and the Space-Based VHF Correspondence Group (CG) has been established in response to this.

Objective and Scope:

The CG is established to develop frequency planning criteria and procedures for new VHF AMS(R)S systems. The outcome from these discussions will be recommendations to the FSMP membership on:

- Proposals for Amendment (PfA) relating to the ICAO Standards and Recommended Practices (SARP's) Annex 10 Volume 5 and planning criteria to be included in Doc 9718 (Handbook on Radio Frequency Spectrum Requirements for Civil Aviation) relating to the implementation of Space-based VHF.
- Their implementation in the associated frequency management tools as appropriate.

Composition:

The CG will be composed of representatives with appropriate skills from the FSMP panel members, advisors, and formal observers.

Working Arrangement:

The Space-Based VHF CG will report its progress and present its outputs to the Working Group of the ICAO Frequency Spectrum Management Panel (FSMP-WG). The Space-Based VHF CG will operate via correspondence and where appropriate convene virtual/physical meetings.

The Space-Based VHF CG will liaise directly with the FVSG, ensuring there is no duplication of effort and that both groups are aware of the work of the other. Any recommendations for external engagement, other than with the FVSG, will be prepared as recommendations to the full FSMP meeting.

The Space-Based VHF CG will operate until the objectives are met. The final draft of the output documents are targeted for delivery to the FSMP in 2025.

Deliverables:

- Annex 10 Volume V SARPS:
  - AOC vs ATC
  - Datalink vs Voice
- Doc 9718, Vol. II - Planning Criteria –.