International Civil Aviation Organization

Seventh Meeting of Aeronautical Communication Service Implementation Co-ordination Group of APANPIRG (ACSICG/7)

Web-conference, 21 – 23 July 2020

Agenda Item 8: Any other business

UPDATE ON SPACE-BASED VHF VOICE COMMUNICATIONS SERVICE

(Presented by Singapore)

SUMMARY

The space-based VHF concept was first endorsed in 2018 by the ICAO Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) and supported by ICAO Communications Panel (CP) and Frequency Spectrum Management Panel (FSMP). Singapore has since embarked on design studies with various communications vendors and satellites service providers. This paper updates the meeting on Singapore's technical studies and encourages States and Administrations to support the potential development of space-based VHF.

1. INTRODUCTION

1.1 Space-based VHF communication is a concept in which aircraft, in particular those operating in remote continental regions and oceanic areas, can communicate with air traffic control (ATC) units by VHF radio via satellite. The technical feasibility studies of this concept began in 2018. The concept when implemented will be a parallel and complimentary system to space-based Automatic Dependent Surveillance-Broadcast (ADS-B), which allows ATC units to receive ADS-B data from aircraft via satellites. Such data include aircraft identification and position (latitude, longitude and altitude) and additional data as appropriate, together with time stamp from the ADS-B receivers on board satellites. The ADS-B technique is termed "automatic" because there is neither intervention from pilots nor interrogation from terrestrial stations, and "dependent" because it depends on broadcasts from aircraft.

1.2 Currently, in remote airspace either continental or oceanic where VHF voice communications (also known as direct controller-pilot communications (DCPC)) is not available, e.g. owing to line of sight limitations or lack of infrastructure, increased separation minima apply. For example, in areas where ADS-B data and satellite-based data communications are available, but without VHF DCPC, ICAO Standards and Recommended Practices (SARPs) require 14 NM longitudinal separation minima. The proposed solution of space-based VHF voice communication could fulfil the role of VHF DCPC in oceanic areas or remote continental regions where effective communications means are unavailable. Together with appropriate surveillance means such as ADS-B, it can potentially enable 5 NM en-route radar-like separation minima.

1.3 The key benefit of space-based ADS-B and space-based VHF voice communications in remote continental and oceanic regions is to provide a significant contribution to airspace ATC efficiency, capacity and safety. The availability of DCPC with surveillance (ADS-B) will avail ATC

more options to handle en-route weather disruptions and other in-flight emergencies that may otherwise be restricted in remote airspace without such capabilities.

1.4 However, at present, there is no viable solution to provide VHF voice services over most of the oceanic and some remote continental areas. There are also areas where it is not cost effective to provide such services. Although High Frequency (HF) voice, satellite voice (SATVOICE) and satellite-based Controller Pilot Data Link Communications (CPDLC) may be used in lieu of VHF voice communications, these technologies are currently not good enough to support radar-like or other similar reduced separation minima (e.g. 5 or 10 NM). Moreover, not all aircraft are equipped with SATVOICE and/or CPDLC. In contrast, space-based VHF voice communications do not require any change of aircraft equipage.

2. DISCUSSION

2.1 Technical Studies on Space-Based VHF

2.1.1 The Civil Aviation Authority of Singapore (CAAS) has initiated a series of technical studies and analysis on space-based VHF radio communications since early 2019. The first study was a technical feasibility study on using a constellation of nanosatellites under 25 kg in an orbit at approximately 600 km altitude above the equator. The study concluded that such a system would have limited coverage around the equator. The payload restriction in the 25 kg class would limit the battery size on-board the host satellites that would in turn constrain the technical capabilities of the constellation for space-based VHF radio communications.

2.1.2 A second technical study was conducted and preliminary assessment completed in Sept 2019. It was concluded that a similar space-based VHF radio communications system using a constellation of minimum 100 kg class satellites could increase coverage, i.e. from equator to a higher latitude. The study also recommended for a more thorough analysis to ascertain where significant gains could be made with regard to the VHF radio design, and more specifically the VHF antenna characteristics of the system on-board the satellite, i.e. multiple receivers/transmitters, optimised antennae and directionality aperture.

2.1.3 A third technical study was sought by CAAS to further the analysis of a space-based VHF radio communications system that can be feasible and cost-effective. The study was commissioned in December 2019. For the purposes of contribution to International Telecommunications Union (ITU) and ICAO technical meetings, the results of this third study are expected to be available by the end of 2020.

2.1.4 Currently, all the technical studies are focused on satellite constellation to provide coverage at an orbit above the equator. When required, the satellite constellation could be redesigned to cover the other regions.

2.1.5 As a further consideration, it is important to understand that the space-based VHF radio relay solutions will work seamlessly with all existing civil aircraft equipped with VHF radio voice communications without any requirement for aircraft avionics modification. In addition, there will be no change to existing terrestrial VHF voice communications. Therefore, **it is expected that there will be no significant amendments to the ICAO SARPs contain in Annex 10**.

2.2 Future Work Regarding Frequency Allocation

2.2.1 An amendment to the ITU Radio Regulations would be required in order to authorize the satellite reception and transmission of VHF radio relay communications to/from aircraft, succinctly expressed an authorization to the AMS(R)S would be required to permit this concept of communications. This requirement is identical to that which was needed at WRC-15 for the AMS(R)S allocation to space-based ADS-B in order to legally authorise the service in accordance with the ITU Radio Regulations.

2.3 Next Steps of Studies on the Space-Based VHF Radio Communications Concept

2.3.1 In the upcoming timeframe, CAAS will continue with the technical studies, with the primary focus on the design of the satellite constellation, coverage optimisation and other technical parameters (e.g. VHF radios and antennae). The Proof-of-Concept trials and verification tests may take place following the completion of the technical studies. For such trials/tests, coordination will be made with the ICAO Asia Pacific Regional Office, and other Regional Offices as necessary, for the required frequencies.

2.4

<table>
<tr><td colspan="4">Conclusion/Decision XX/XX - UPDATE ON SPACE-BASED VHF VOICE COMMUNICATIONS SERVICE</td></tr>
<tr><td colspan="3">What: The Meeting is invited to:

a) note the ongoing design studies of space-based VHF voice communications;

b) note the potential coverage of the proposed satellite constellation that will benefit a large number of States and the aviation community;

c) invite interested States and Administrations to join Singapore in the space-based VHF technical studies and POC trials;

d) urge States and Administrations to actively participate in the relevant ICAO and ITU WP5B meetings, in particular for the space-based VHF agenda item;

e) urge States and Administrations to actively support the ICAO positions, in particular for the space-based VHF agenda item, at relevant ITU meetings; and

f) discuss any relevant matters as appropriate.</td><td>Expected impact:
☒ Political / Global
☒ Inter-regional
☐ Economic
☐ Environmental
☒ Ops/Technical</td></tr>
<tr><td>Why:</td><td>As explained in the paper</td><td>Follow-up:</td><td>☒Required from States</td></tr>
<tr><td>When:</td><td>21-Jul-20</td><td>Status:</td><td>Draft to be adopted by PIRG</td></tr>
<tr><td>Who:</td><td colspan="3">☒Sub groups ☒APAC States ☒ICAO APAC RO ☒ICAO HQ ☐Other: XXXX</td></tr>
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3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) review the ACSICG/7/WPXX conclusion.

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