



ICAO

International Civil Aviation Organization

Eleventh Meeting of the FANS Interoperability Team – Asia
(FIT-Asia/11)

Video Teleconference, 23 – 27 August 2021

Agenda Item 4: Review of ADS-C/CPDLC Operations and Performance

REVIEWING THE L888 HF ISSUES

(Presented jointly by China and Boeing CRA)

SUMMARY

This paper presents the history of the ADS-C HF downlink messages auto-switching issue discovered on route L888, reviews its development, and evaluation of its mitigation as well as its current status.

1. INTRODUCTION

1.1 In FIT-Asia/4 meeting, a PBCS performance report was submitted by China to present its data link service issues that arose in 2014. In the presentation, the low ADS-C HF downlink (A-HF) performance on route L888 was noticed by the meeting. China claimed to receive reports from the operators where the data link service media automatically switched from other media to HF communication, potentially resulting in low performance.

1.2 An action was created by the meeting that “(China) Provide problem reports to CRA of switching to HF in areas where good SATCOM coverage exists.”

1.3 This paper provides the meeting with the information on the action, summarizing the existing status of the HF issue and actions taken. It serves as a chance for the meeting to review the action, its development, and decide whether further actions should be taken as appropriate.

2. DISCUSSION

Background information

2.1 In the fourth meeting of FIT-Asia, states including China, India, Indonesia, Japan and Singapore provided their respective data link reports for the meeting to review. During the discussion, China presented the performance in Chengdu FIR (ZUUU), Lanzhou (ZLLL), and Urumqi (ZWWW), and informed the meeting that there seemed to be issues with the HF ADS-C downlink transmission on route L888.

2.2 The first issue is that the performance was under-criteria. The HF ADS-C downlink performance averages on route L888 were 87.89% (<300s) and 93.44% (<400s), lower than the 95% and 99.9% requirements respectively. On the other hand, the HF performance for CPDLC was met at 100% for both 300s and 400s requirements, so this issue was more scoped within the HF ADS-C downlink performance. The meeting should note that the presentation was very much different from the current one, the data from L888 were also measured against the RCP 400 and RSP 400 requirements, since the longitudinal separation adopted was ten minutes.

2.3 A second issue is that the HF communication serves as an alternative media on route L888, yet the total HF messages count obviously exceeded the normal level, reaching 2,494 in one year. In the period spinning from Feb 2013 to March 2014, the message count also accumulates to 3,152. This means the A-HF issues might have existed before FIT-Asia/5. On the other hand, after further study, it should also be noted that the HF message counts for CPDLC were only 4 and 10 for the two years. China expressed concerns that it received reports that several aircraft encountered issues where communication media switches automatically, especially switching from VHF to HF, resulting in extremely high HF message counts and potentially lower performance. China and Boeing CRA thus reached stakeholders for further investigation afterward.

2.4 Summarizing the early discussion, the report cast two challenges to the L888 PBCS operation. The first is the HF's low performance, and the second is the automatic switching between media. China intended to investigate the issues further and it was also agreed by the meeting that China would provide the information of the auto-switch aircraft types to Boeing CRA, since the original data was organized by the other stakeholders.

2.5 An action was thus created by the meeting that “(China) Provide problem reports to CRA of switching to HF in areas where good SATCOM coverage exists.”

Further development

2.6 After the meeting, China and Boeing CRA established contacts and had exchanged information on the issue. The liaison by then was reflected in the FIT-Asia/6 WP04. During FIT-Asia/6, China mentioned that the HF malfunction might be a result of certain local ATM systems and/or procedural issues. It was also demonstrated that the HF ADS-C downlink message count reached 4,296 in the year 2015. The increase from 2,494 from last year to 4,296 this year is a result of the involvement of Kunming FIR (ZPPP), a new FIR that started its PBCS implementation in the year.

2.7 In FIT-Asia/7, the data showed that the AHF message count in the year 2016 was reduced to 2,203, among a total of 1,893,633 HF messages. The obvious drop of the A-HF message count saw a general improvement in the overall data link operation.

2.8 In FIT-Asia/8, China informed the meeting that the Chengdu FIR and Kunming FIR ended their PBCS operation in 2017, leaving the Lanzhou FIR and Urumqi FIR running the PBCS operation. In the year, the HF message counts were not widely included into the performance table by the meeting, disabling the paper to collect the A-HF issue for this year.

2.9 In FIT-Asia/9, 466 A-HF messages were reported among 1,228,303 total HF messages in the year 2018. There was a sharp decrease in the count from 2,203 to 466, the overall messages also dropped simultaneously.

2.10 In FIT-Asia/10 and FIT-Asia/11, 141 and 65 A-HF messages were found among 1,012,884 and 498,614 ADS-C messages in the two FIRs. China mentioned in the problem report that certain aircraft tended to use HF communication even the other media were available. Yet China was unable to collect the raw data, since the raw data are managed by ARINC.

Reviewing the action

2.11 To review the action, one essential step is to determine whether the HF issues are solved. The first issue relevant to the action was the low HF performance. The paper believes the meeting is adopting RCP 240/D and RSP 180/D specifications, and the low-performance was measured against the RSP 400 specification, where low HF performance is recognized as a more empirical issue, so this issue is not recommended by the paper to emphasize within this action.

2.12 And more importantly, VHF and SATCOM, the primary and the first alternative means of data link communication, fully cover route L888, providing a satisfying service for the general PBCS operation. In the year 2020, the total ADS-C message count reached 323,547, and among them only 35 messages were transmitted with HF, taking up merely 0.01% proportion of all peer messages. China and Boeing CRA thus recognize that the HF performance will not necessarily affect the general PBCS operation on route L888, since it is hardly used in practice.

2.13 Besides the first issue, the A-HF auto switch issue is intended to be stressed in the paper. The first step for the meeting is to determine if the issue itself is properly solved. The A-HF counts for each year appear to be an appropriate indicator for this study.

2.14 The figure below compares the total A-HF counts and the total ADS-C message counts on a yearly basis. It should be noted that the number of the FIRs involved, however, changed a number of times during the years from 2014 to 2020, resulting in the ups and downs of the overall ADS-C messages, and simultaneously making the comparison alone less convincing.

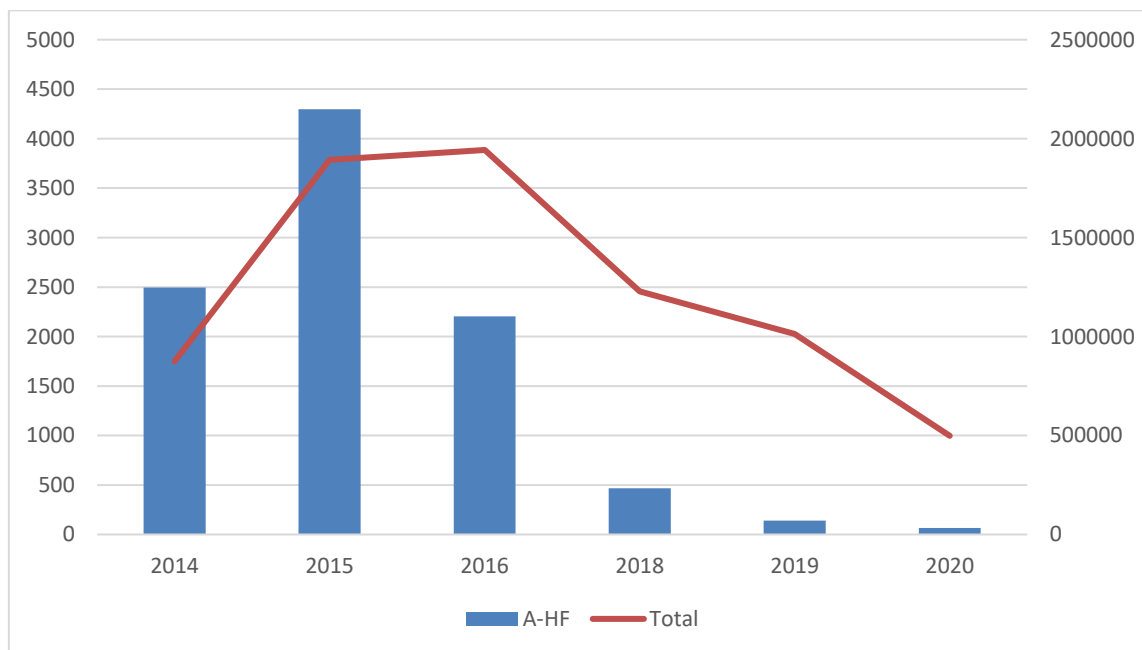


Figure 1

2.15 In order to optimize the method, the paper adopts an A-HF count and A-HF/total ratio for comparison on a yearly basis. From the figure below one can see that although the A-HF count rose in 2015, the ratio indeed decreased by 0.05%. And the six sample years show a constant drop of the A-HF ratio, reflecting the general improvement in the operation and also mitigation of the auto-switching issue. Eventually, the A-HF ratio stabilized below 0.015%, proving the A-HF messages to be a very low proportion of the overall ADS-C messages since 2019.

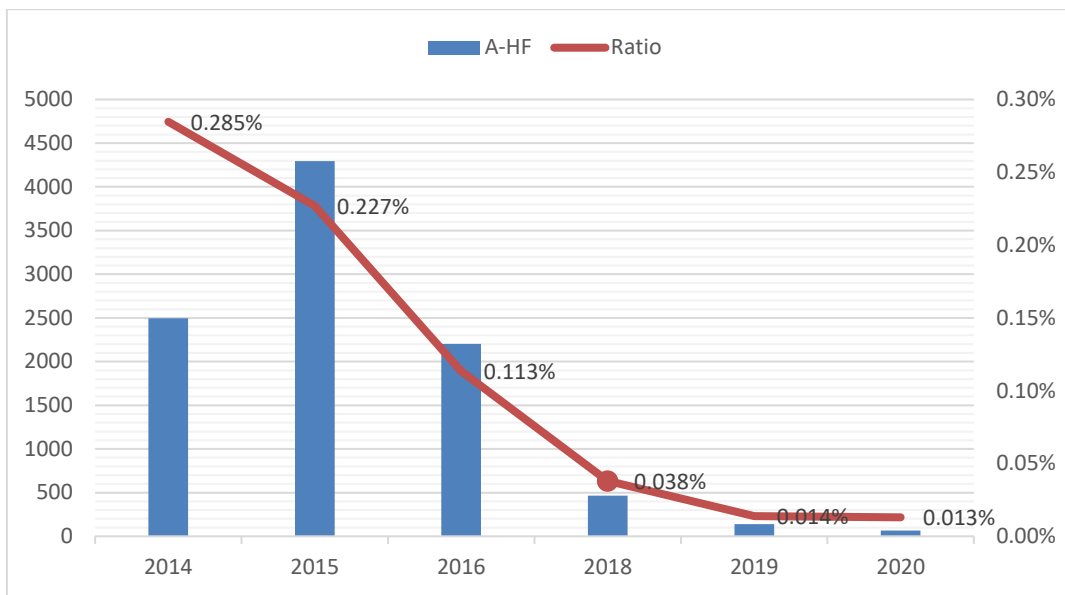


Figure 2

2.16 In conclusion, based on the marked improvement in HF performance, China and Boeing CRA believe Action 4/4 is complete. It is believed that this is due to a combination of avionics and network improvements. Most importantly, there have been several impactful changes in the available avionics such as identifying next on busy and SATCOM improvements which have helped performance and reverting to HF.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

- a) note the information contained in this paper; and
- b) decide if the action should be considered completed.

.....