International Civil Aviation Organization

The Twelfth Meeting of the FANS Implementation Team, Bay of Bengal (FIT-BOB/12) and the Second Meeting of the Bay of Bengal Reduced Horizontal Separation Implementation Task Force (BOB-RHS/TF/2)

Bangkok, Thailand, 22 – 26 February 2010

Agenda Item 4: Review Bay of Bengal ADS/CPDLC Operations

Report On CPDLC / ADS-C Bench Testing With Chennai and Mumbai Centers

(Presented by Boeing)

SUMMARY

This information paper presents the progress report of ADS/CPDLC bench testing with Mumbai and Chennai FIRs.

1. Introduction

1.1 In support of separation reductions based on the use of FANS 1/A+ in the Bay of Bengal region the Central Reporting Agency (CRA) is working together with regional FIRs to ensure systems and procedures are performing as required.

1.2 The CRA uses a comprehensive suite of avionics systems and associated test equipment and simulation computers to conduct these focused bench tests. The avionics suite or "bench" simulates full aircraft systems capabilities from a CPDLC and ADS standpoint. Once connected to either ARINC or SITA's ACARS network the bench can logon to any FANS ground automation system around the world. Once connected, test bench aircraft appear just like any other flight operating in that airspace.

Note: When bench testing with operational systems additional coordination of initial aircraft position, altitude, speed, and route of flight is required to ensure there is no impact on operations.

2 Overview of testing conducted and of the CPDLC connection transfer process.

2.1 Since January 2010 three bench tests have been conducted with both Chennai and Mumbai FIRs. Approximately 10 hours of total test time have been accumulated since the beginning of the year.

2.2 This first phase of testing is focused on automatic connection transfers between Chennai and Mumbai centers. Future auto-handoff tests will be conducted with neighboring FIRs.

2.2.1 A CPDLC connection transfer involves the Active center, or the center which holds the current CPDLC connection transferring the CPDLC connection to the next downstream center know as the Next Center. The connection transfer process is not complex however the transfer sequence must be followed exactly as described below or the automatic handoff to the next center will not be successful. The ADS connection does not get transferred. Only the CPDLC connection gets transferred or handed off to the next downstream center. ADS connections are managed by the FIR's themselves and the GOLD document provides detailed guidelines on ADS connection etiquette.

2.2.2 CPDLC Connection Transfer Sequence

1 – The Active Center or the center that currently holds the CPDLC connection nominates the next downstream center by up-linking a Next Data Authority (NDA) message.

2 – Then the active center sends a message to the aircraft CPDLC application to automatically forward a logon request to the center identified in the uplinked message. A FNCAD message is the message sent to the airplane which includes the seven character address for the next center. Note: the seven character address is different from the four letter identifier that the flight crew types in when manually logging on.

3 - Once the aircraft receives an FNCAD message the CPDLC application automatically forwards a connection request message, FNCON (connect request message), to next center identified by the seven character address in the FNCAD message.

4- The next center does not need to know if the FNCON message is being forwarded through the aircraft from the previous center or if it is receiving the FNCON message as a result of a manual logon request from the from the aircraft. The next center does the appropriate flight number and tail number checks checking the data included in the FNCON message against the data received in the flight plan. If the data in the down-linked FNCON matches the data in the filed flight then the ground system responds to the aircraft with a FNRESR response message acknowledging the logon request..

5 – Once the aircraft receives the FNRESP message from the next center the aircraft sends a complete message to the Active Center. The FNCOMP message tells the Active center the address forwarding process was successful and that they can now release the CPDLC connection to the next center.

6- The Active center sends the End Service message to the aircraft. Once the aircraft receives the end service message the Next Center will become the Active Center and the Next Center field will be blank.

3 Testing Setup And Initial Conditions

3.1 During bench testing the CRA looks at all the message traffic between the aircraft and the ATSU in near real time. The CRA monitors the raw message traffic and also decodes each message as it is received by the aircraft.

3.2 By reviewing both the raw or encoded message traffic and the decoded message traffic the CRA can monitor for encoding errors, bad CRC calculations, adherence to proper procedures as defined in the GOLD document.

3.3 The test setup was as follows;

- Logon Code Chennai = VABF
- Logon Code Mumbai = VOMF
- Flight Number = BOE7871
- Tail Number = N7872BO
- Initial Position = 16.48 N, 75.05E
- Initial altitude = FL39 to FL41
- Initial Speed = .85
- Route Of Flight =

AGELA
BOGAT
DORAM
VIRAM
VABDI
GURAS

4 Results of ADS/CPDLC Bench Testing with Chennai and Mumbai Centers

4.1 Working together Chennai center, Mumbai center, and the CRA were able to identify some issues which are contributing to automatic CPDLC handoff problems. Both Chennai and Mumbai centers understand these issues and are working closely with their suppliers to resolve them. Once the new software release is installed the CRA will conduct additional tests to confirm the update is working as planned.

4.2 Following is a detailed list of the issues identified from dedicated bench test sessions. In addition to issues identified relating directly to auto handoffs a couple of other related issues were identified as noted below.

1 - The end-service from Mumbai to try to transfer to Chennai had the um159 (error message) in it: /BOMCAYA.AT1N7872BO805093E700D8
ATC DL Uplink Message AT1 - BOMCAYA - N7872BO - CRC is valid 0,,
0(161): End Service 1(159): Error [error] errorinfo(): commandedTermination

When the End Service Message is sent it must be sent by itself or concatenated with a “Contact” or “Monitor” message.

2 - Incrementing MIN

The FANS protocol establishes a Message Identification Number or MIN for each uplink. FANS specifications recommend incrementing the MIN from zero to sixty four for each uplinked message. However some systems continue to use the same MIN over and over each time a message dialog is closed (response received to an uplinked message such as Roger or Unable). Although this is not directly related to handoff problems it is related and can cause irregular

3 - Including time stamp in uplinks

The FANS protocol specification defines the use of time stamps in CPDLC and ADS up-links as optional. However it is good recommended practice to include the optional time stamp with each up-link. Including the optional time stamp referenced to UTC will reduce the likelihood of inadvertent avionics behavior as well as helping engineers investigate problem reports.

4. Use of free text that looks like a report request

Care should be taken and training reinforced with the use of free text. Although we were in a test environment and controllers were not strictly following required procedures to facilitate testing some free text messages were up-linked requesting reports which could have been requested using standard FANS report messages. Using the standard FANS messages instead of free text enables airborne applications to make full use of built in automation.

5 Conclusion

5.1 The CRA continues to work together with Bay of Bengal ATSUs to progress FANS operations in the BoB region. As ATSUs update automation software additional testing will be coordinated.

6 Action by the meeting

6.1 The meeting is invited to review the outcomes of the operational trials and to take note of the information provided in this information paper.

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