International Civil Aviation Organization

THE THIRD MEETING OF ADS-B STUDY AND IMPLEMENTATION TASK FORCE (ADS-B TF/3)

Bangkok, Thailand, 23 – 25 March 2005.

Agenda Item 4: Review States' activities on trials and demonstration of ADS-B

EVALUATION STATUS OF ADS-B AND MULTILATERATION AT ENRI

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(Presented by Japan)

SUMMARY

ENRI (Electronic Navigation Research Institute) is conducting an evaluation of 1090MHz ADS-B and multilateration. This information paper describes the status of the evaluation at ENRI.

1. Introduction

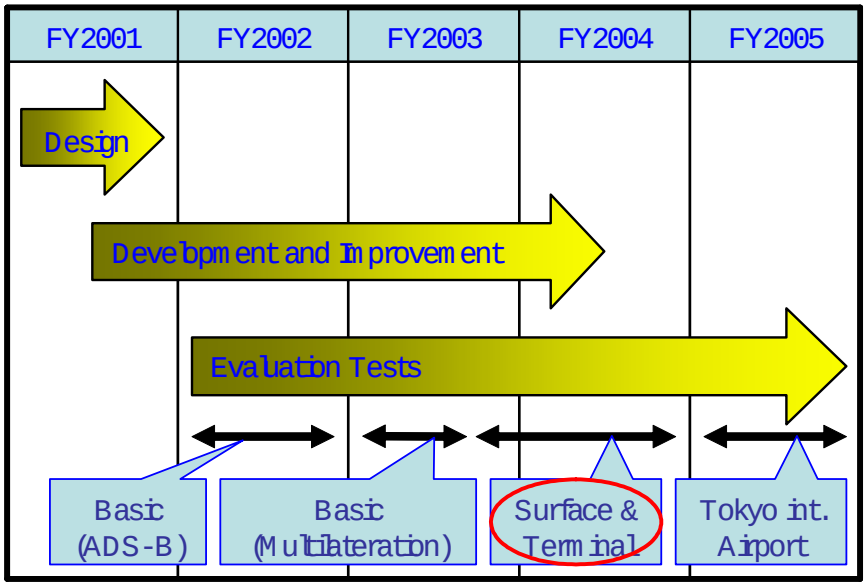
1.1 ENRI (Electronic Navigation Research Institute) is conducting an evaluation of 1090MHz ADS-B and multilateration. This information paper describes the status of the evaluation at ENRI.

2. Evaluation plan

2.1 The main object of the evaluation is an establishment of 1090MHz ADS-B technology in Japan. Table 1 represents the evaluation plan. ENRI started the development of an experimental system in FY2001. Mode S extended squitter was selected as the data-link media of the experimental system. The reasons are that the extended squitter is the only ADS-B data-link media which has globally assigned radio frequency and the squitter is most appropriate to avoid a duplex installation of avionics because many commercial aircraft have already equipped Mode S transponder for ACAS. The experimental system has a multilateration capability in order to compliment ADS-B.

2.2 In this fiscal year, evaluation tests of ADS-B and multilateration are being conducting on surface and terminal areas. The evaluation of multilateration takes priority over the ADS-B, because Japan civil aviation bureau plans to introduce the multilateration system to Tokyo international airport for surface surveillance. Therefore ENRI is going to conduct an evaluation of multilateration at Tokyo international airport in the next fiscal year.

Table 1 Evaluation plan



3. Experimental system

3.1 Figure 1 represents the structure of the experimental system. The experimental system consists of 6 remote units, a reference unit, a target processor, a monitor equipment, and an experimental aircraft. The reference unit transmits squitter signal in order to calibrate time synchronization between the remote units. Figure 2 represents the block diagram of the remote unit.

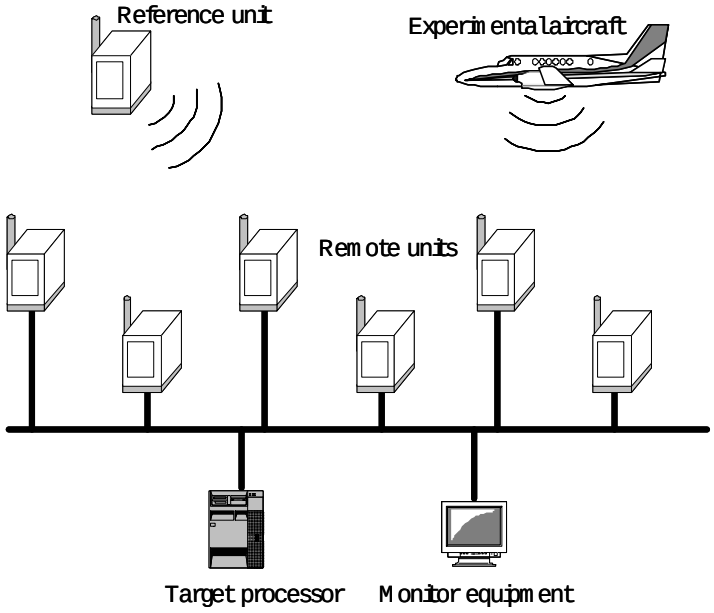


Figure1 Structure of the experimental system

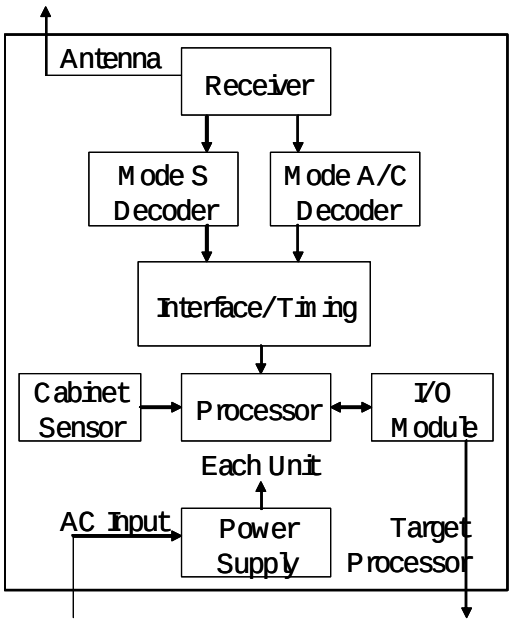


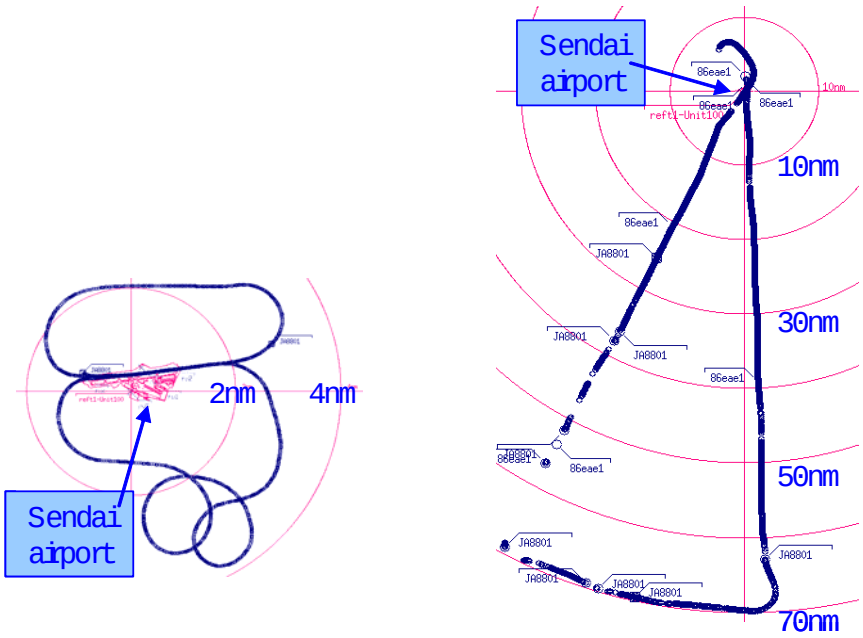
Figure 2 Block diagram of the remote unit

4. Evaluation status of ADS-B

4.1 The experimental system is installed at Sendai airport, about 200NM north east of Tokyo. Figure 3 represents the location of Sendai. The evaluation tests of ADS-B on terminal area were conducted using the experimental aircraft (Beechcraft B-99) on March of 2004. Figure 4 shows the picture of the experimental aircraft. ADS-B avionics which consist of a Mode S transponder (ACSS XS-950), a Processor unit (UPS-AT AT9051), and a GPS receiver are being equipped in the experimental aircraft. The GPS receiver is corrected by a differential GPS system which is operated by Japan Coast Guard. The tests were conducted on Sendai terminal area. Figure 5(a)(b) represent the tracking outputs by ADS-B in the traffic pattern and the terminal area respectively. The flight levels were 1,500ft in the traffic pattern and 9,500ft in the terminal area. The target update rate was 1sec. Good tracking result was taken for the traffic pattern on the tests. However, some lost targets that are depended on heading of the aircraft occurred at long range. We are now investigating the cause of the lost targets. Next flight trial will be conducted on March 2005.

Figure 3 Location of Sendai

Figure 4 Experimental aircraft



(a) Traffic pattern (b) Terminal area

Figure 5 Tracking outputs by ADS-B

5. Evaluation status of Multilateration

5.1 The evaluation tests of multilateration on surface area have been conducted from December 2003. The tests are conducted using the experimental vehicle. Figure 6 represents one of the tracking outputs on the multilateration tests conducted on December 2003. As a whole, the test results were satisfactory in comparison with EUROCAE MOPs. However, target losses were observed in several locations, especially in front of the terminal building. Also large errors were observed at the left and right corners. We found that target losses are caused by shielding and reflection from buildings or parking aircraft and large errors tend to occur when going out of the triangular formed by remote units. In order to resolve these problems, an antenna height was extended and a remote unit was added near the terminal building area. The tests applied with these improvements were conducted on September 2004. Figure 7 represents the comparison of tracking outputs near the terminal building area between December 2003 and September 2004. We confirmed that the problems of target losses and large errors were almost solved.

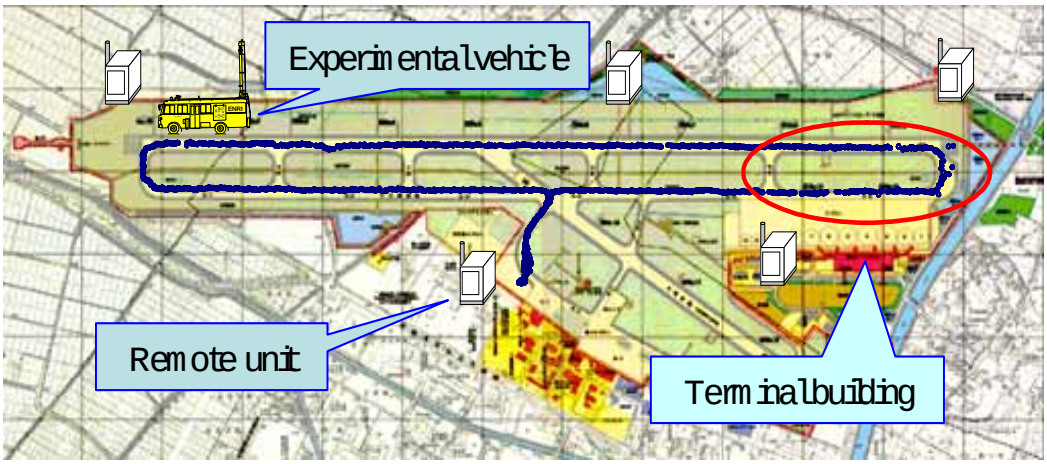
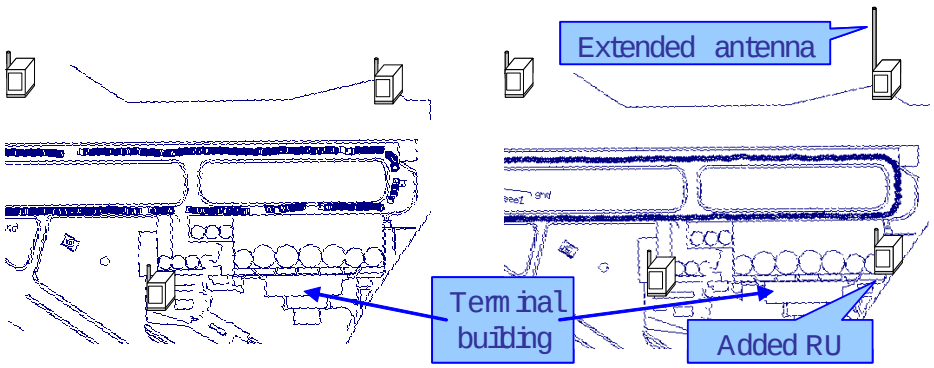


Figure 6 Tracking output by multilateration



(a) December 2003 (b) September 2004

Figure 7 Comparison of tracking outputs near the terminal building area

6. Conclusion

6.1 The meeting is invited to note the information above.
