International Civil Aviation Organization

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST SEMINAR AND ELEVENTH MEETING OF AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/11)

Jeju, Republic of Korea, 24-27 April 2012

Agenda Item 6: Review States' activities and interregional issues on trials and implementation of ADS-B and Multilateration

A REVIEW OF CURRENT ADS-B SERVICE IN REPUBLIC OF KOREA

(Presented by the Republic of Korea)

SUMMARY

This paper provides the information on the ADS-B installation and the services at Incheon International Airport, Republic of Korea.

1. Introduction and Background

1.1 At the Incheon International Airport(IIA), four ADS-B systems were installed and have been operating since 2008.

1.2 ADS-B system at IIA has been operating to detect approaching aircrafts into the airport and moving vehicles on the ground providing effective SCA(Surface Conflict Alert) function and fostering smooth air traffic flow.

2. Review of current ADS-B service in Republic of Korea

2.1 Current ADS-B system at IIA in Republic of Korea.

ADS-B Ground station (1090ES):	4
ADS-B Vehicle transmitter:	50
※ Other Surveillance systems of IIA	
- ASMGCS interfaced with SMRs and ADS-B:	1
- X-Band SMR:	1
- Ku-Band SMR:	1
- ASR/SSR:	2
- ARTS(Automated Radar Terminal System)	1

ADS-B information is used for supporting the surveillance on airport surface movements and for monitoring simultaneous instrument approaches (Monitoring of Non-Transgression Zone, NTZ).

2.2 Current status of ADS-B system

In the Korean airspace, about 55% of aircrafts broadcast their positions though ADS-B 1090ES. The following table shows the list of aircrafts with "ADS-B OUT" of the airline, Korean Air, as of 2011.

Type of Aircraft	No. of Aircraft	With ADS-B out	other
B777	28	28	0
B747	42	42	0
B737	31	10	21
A330	29	19	10
	130	99(76%)	31(24%)

Table1. ADS-B OUT readiness (Korean Air)

The Figure 1 in the attachment shows NUC value distribution from flights. And the Figure 2 shows the trend of the number of ADS-B track for a day.

If you examine figure 4, **Time interval between ADS-B reports**, it demonstrates that flights in close range to the airport make more frequent ADS-B reports than flights at distance.

2.3 Issues on current ADS-B operation

Trajectory smoothness difference among ADS-B reports
The Figure 5 in the attachment shows the trajectories of two ADS-B reports and their smoothness are different in some degree. In the current ATC system, even though their smoothness difference does not make any problem for the operation, what ADS-B track quality showing different even in same NUC=7 case shows seems abnormal.

Continuous position errors derived from ADS-B reports with lower NUC value
Some flights with NUC=0 are tend to make position errors in their ADS-B reports. The position error can be ranged from 50 meters to 2,000 meters. When a flight with normal NUC value makes any position error, it could be recommended that the airline would deactivate ADS-B or adjust their NUC value to ZERO. Figure 6 give some examples of flights with NUC=0.

ADS-B vehicle transmitter
There are 50 vehicle transmitters in operation in IIA. Some problem such as installation difficulties and limited equipment number are impeding vitalization of utilizing vehicle transmitters. Also there are some doubts about why quite a number of vehicle transmitter must use 1090Mhz frequency. 1030Mhz and 1090Mhz are most important resource in avionics, especially for IIA and it could deplete the core resource.

3. Future of ADS-B service in Korea.

The current ADS-B data usage remains at ASMGCS, SCA, and NTZ monitoring services. But IIA will implement a MLAT system within 2015 and utilize the current ADS-B system to improve ground surveillance accuracy with a new SMR RADAR on a new ramp control tower which will be completed in the 3rd phase construction within 2017. Also the ADS-B system will be one of the key surveillance systems which will improve surveillance ability for airborne flights providing the approach control and the En-route control with more reliable air traffic surveillance service.

4. Conclusion

For the safety, ADS-B OUT quality must be constantly monitored by ATC system in terms of their position errors. Also for more confident airport surveillance, IIA is considering implementing a MLAT system in addition to the current ASMGCS interfaced with ADS-B and planning to complete the implementation within 2015 to enhance the aircrafts' safeties. Finally, IIA hopes that more aircrafts equip ADS-B systems for those safe and IIA will be with them.

5. Action by the meeting

5.1 The meeting is invited to note that the information described in this paper.

– – – – – – – – – – –

ATTACHMENT 1. Statistical data of ADS-B

1. NUC value distribution

The following pie chart shows the distribution of NUC value of ADS-B tracks. The NUC values were collected for a day (20120331). Note that the position report from same flight is counted as one. If you look at the Figure 1, you can find the more flights ready for the ADS-B service. The data includes the all flight detected by ADS-B receivers at Wang-San radar site. So if there are the flights departed from other local airport, the flights are also included.

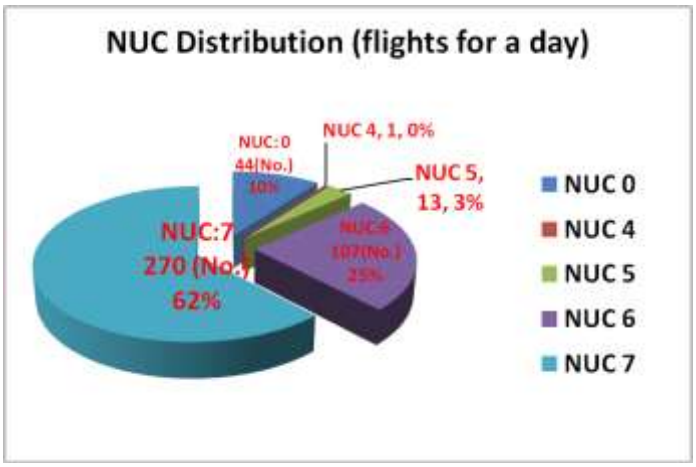

Figure 1, NUC distribution

2. The number of ADS-B tracks

The following chart shows the daily change of the number of ADS-B tracks and RADAR tracks. Here, X-axis means the local time and Y-axis means the number of track. ADS-B Out service ratio is about 55% at the peak time and the ratio has increased from the past. At night time, Because the number of airborne flight is fall and the number of ADS-B ground tracks is relatively increased, the number of ADS-B tracks reaches those of SSR tracks.

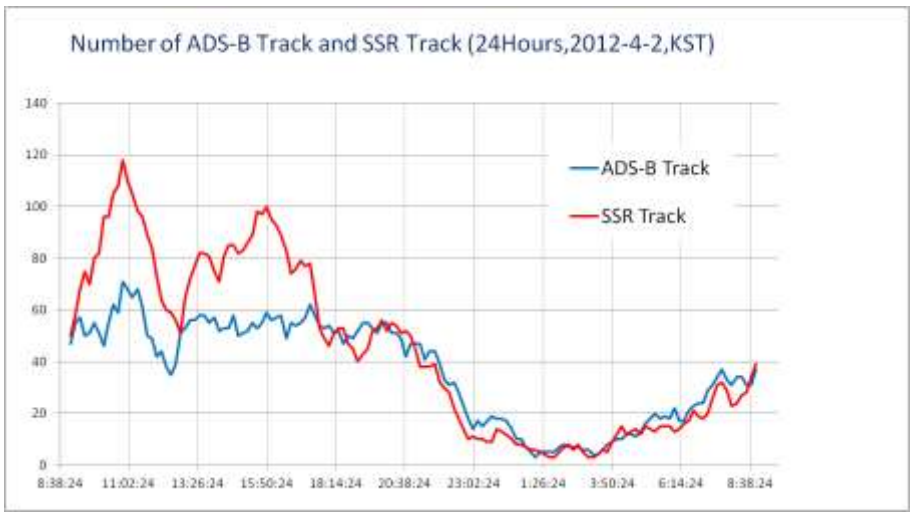

Figure 2, the trend of ADS-B track number alteration

3. The coverage of ADS-B track and SSR RADAR track

The following chart shows the coverage of ADS-B tracks and SSR RADAR tracks. X-axis means distance (NM) from ADS-B sensors and Y-axis means FL(flight level). ADS-B receivers are located at Wang-San and Ramp control tower. The ADS-B system of IIA is installed for the purpose of ASMGCS and SCA(Surface Conflict Alert), so though low gain omni-directional antennas are implemented ADS-B coverage is more than 250 NM thanks to the nature of the system. When you study the empty lower part of ADS-B coverage, you will find that domestic flights are not ready for the ADS-B. The both charts show that the ADS-B tracks at distance are frequently missed. When errors occur, there are some zero altitude tracks on both sides. Please be aware that ADS-B installed at IIA, Model number AS680, is product of Thales ATM and some other models can bring different results.

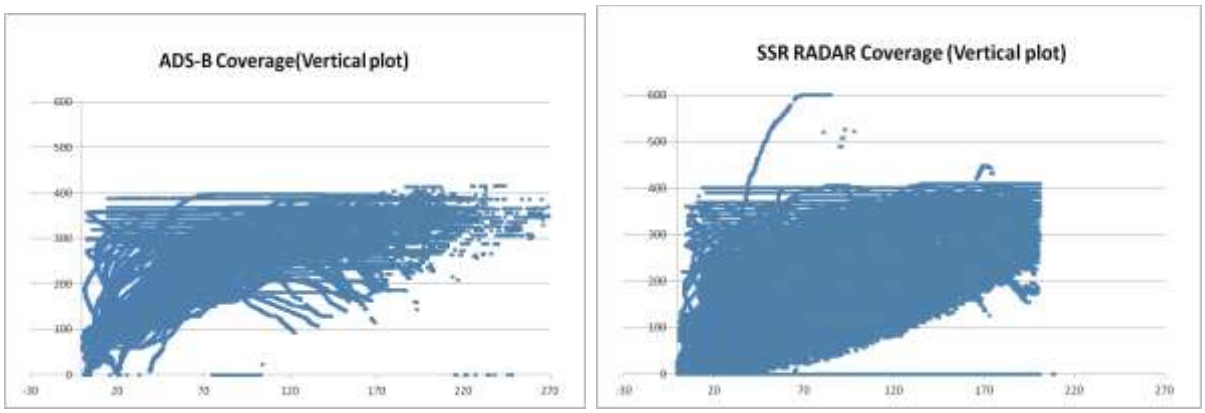

Figure 3. Vertical coverage of track data

4. The time interval between ADS-B reports

The chart plots the time interval among ADS-B reports. Y-axis means time interval in Second among ADS-B reports and each distance from sensors to a flight is plotted along X-axis. Close flights from sensors make the frequent ADS-B messages about below 1 second frequency and the time interval deviations increase as range goes further distance. One ADS-B ground station can receive and detect the signal in the range of 250NM but for more frequent report, more ADS-B ground stations are needed in the same region. It is also desirable that data sharing project among countries is initiated.

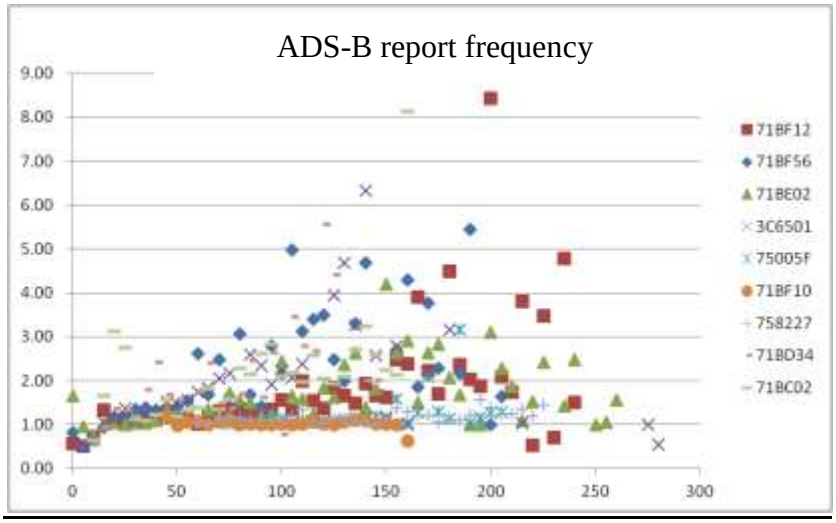

Figure 4. ADS-B report frequency

5. Trajectory smoothness

The quality of the ADS-B target report depends on thereof the ADS-B OUT equipments on flights. The following Figure shows two trajectories belonged to the each flight. The left one is the trajectory of *71BE0** and the right one is its of *841EE**. On account of that the left flight moves in zigzag manner, It is hard to say the left track is abnormal, but the target trajectory is not smooth enough compared to the other target.

When we use ADS-B report as the source data for ATC control, the controller must be aware the fact that ADS-B report quality is dissimilar. In the case of ASR/SSR radar, track quality can be said well established.

Figure 5. ADS-B flight trajectory

6. Position errors with NUC=0 flights

The ADS-B reports from a flight with NUC=0 often make the continuous position errors. The figure 6 is one of the examples.

Figure 6 Position error cases from NUC=0 flights

7. Position error of flight with NUC=7

The report from NUC=7 flight also can cause position errors but the occurrence is very rare and even limited to a report. Figure 6 shows a case of path deviation of roughly 40m. Two ADS-B receivers decoded the same report and it has the position error by 40m.

Picture 6 Position error from NUC=7 flights

8. Abbreviation

IIA	Incheon International Airport
SCA	Surface Conflict Alert
ASMGCS	Advanced Surface Movement Guidance and Control System
SMR	Surface Movement Radar
ASR/SSR	Airport Surveillance Radar, Secondary Surveillance Radar
NTZ	Non Transgression Zone
1090ES	1090Mhz Extended Squitter
MLAT	MultiLATeration
MLTM	The Ministry of Land, Transport, Maritime Affairs
RVSM	Reduced Vertical Separation Minimum
RIMCAS	Runway Incursion Monitoring and Conflict Alert System

– – – – – – – – – – – – –