



*International Civil Aviation Organization*

**FOURTEENTH MEETING OF THE  
COMMUNICATIONS/NAVIGATION/SURVEILLANCE  
AND METEOROLOGY SUB-GROUP OF  
APANPIRG (CNS/MET SG/14)**



Jakarta, Indonesia, 19 – 22 July 2010

---

**Agenda Item 5, 6 : Navigation, Surveillance**

**The R&D activities on ADS-B, GBAS system technologies in the Republic of Korea (ROK)**

(Presented by the Republic of Korea)

**SUMMARY**

This paper describes the R&D activities related to ADS-B (Automatic Dependent Surveillance - Broadcast) and GBAS (Ground Based Augmentation System) technologies in the Republic of Korea (ROK).

**Strategic Objectives,**

- A. Safety – Enhance global civil aviation safety
- D. Efficiency - Enhance the efficiency of Aviation operations.

**Global Plan Initiatives :**

- GIP - 9 Situational awareness
- GIP - 17 Data-link applications
- GIP - 21 Navigation infrastructures
- GIP - 23 Aeronautical radio spectrum

**1. INTRODUCTION**

Based on the CNS/ATM R&D road map for 2005~2020 in the Republic of Korea(ROK), the Korean government will undertake 19 research programs on next generation aviation safety facilities step by step. Among them GBAS and ADS-B technologies are being developed during 2010~2014 in the ROK which are recommended by the ICAO (International Civil Aviation Organization) standards, particularly focusing on the certification and operation technologies. These systems will be implemented in Korean territory after the successful development of GBAS and ADS-B test-bed system.

## **2 BACKGROUND**

- 2.1 The ROK is geographically located at the hub of northeast Asia, but the airspace is much limited due to its mountainous terrain. And Korea needs advanced technologies that can handle the increasing air traffic volumes.
- 2.2 The number of international flight is continuously increasing in Asian region, particularly in northeast Asia including China and Japan. The number of air routes was 190 ten years ago, but now it is about 440. The air traffic volume is also expected to be increased 8.4% annually in average despite global economic recession. So it is required to increase airport capacity and aviation safety in Korea.
- 2.3 Aviation carbon emission is 2.5% of total ROK carbon emission, which shows similar trend to the global one. But aviation carbon emission itself is increasing 4.6% annually due to increasing number of aircrafts (annual average of 5.5%) for the last decade. It is important now to show concern about the environmental problem by reducing the carbon emission with airport waiting time reduction, efficient use of airspace, introduction of the performance based navigation, etc.
- 2.4 This document describes the R&D activities on ADS-B and GBAS technologies which started in 2010 in the ROK, based on the ICAO CNS/ATM standard recommendation.

## **3. R&D ACTIVITIES ON ADS-B AND GBAS TECHNOLOGIES IN KOREA**

### **3.1 Development of the ADS-B Surveillance System**

#### **3.1.1 Summary of the ADS-B Surveillance System**

3.1.1.1 ADS-B is one of the CNS/ATM technologies in order to improve the capabilities of a pilot's air-situational awareness and a controller's air-traffic management by sharing air-to-air and air-to-ground surveillance data cooperatively.

3.1.1.3 The Figure 1 illustrates the ADS-B operational concepts in a transitional stage from the current PSR/SSR surveillance systems to ADS-B system. PSR/SRR and ADS-B would be operated at the same time in order to validate the Availability, the Integrity and the cost-performance effectiveness of ADS-B system.

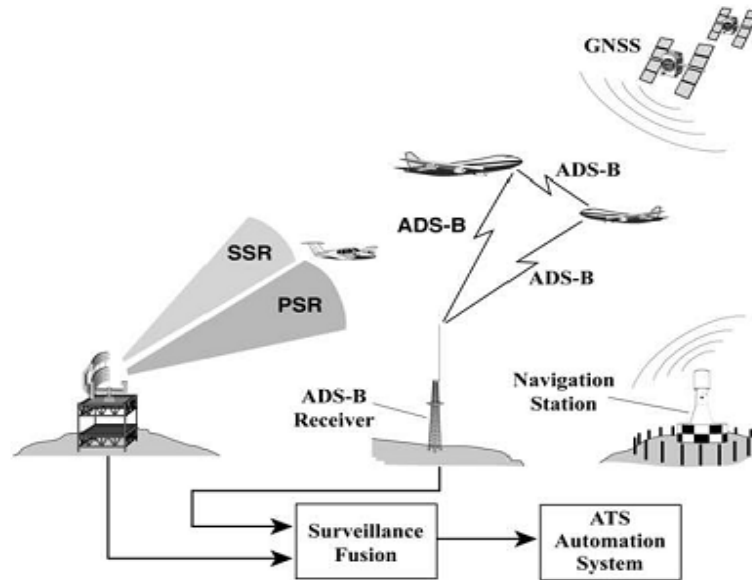


Fig 1. ADS-B system operation concept in a transitional stage

3.1.1.3 The Figure 2 represents the fully developed ADS-B system operation concept. The SSR would be substituted by ADS-B system, and both PSR and ADS-B system will be finally used as surveillance systems.

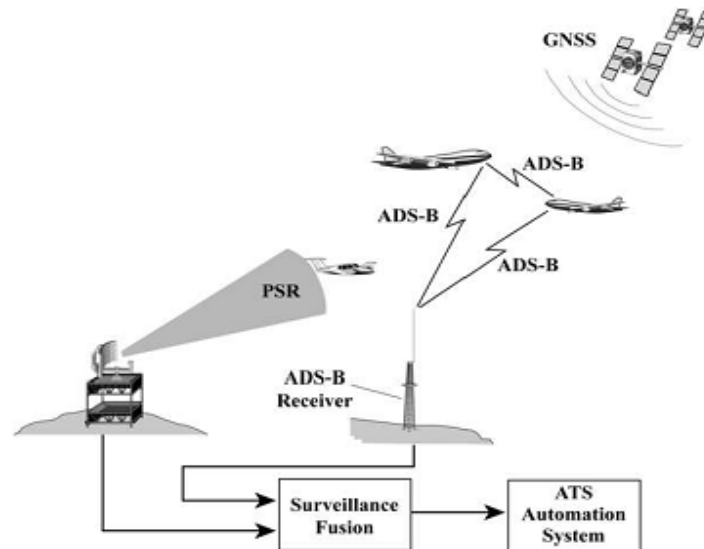


Fig 2. A fully developed ADS-B system operation concept

3.1.2 Necessities of the ADS-B system development in Korea

- A. Korea has the one and only Incheon FIR and there are 15 airports and dozens of air-routes which are under surveillance based on air-route Radars, approach Radars and surface surveillance Radars. But, at present, we are forced to pay tremendous cost in the establishment, maintenance and operation of Radar facilities acquired from overseas. And we are also facing problems like site acquiring cost, environmental damage and so on due to the construction of new radar facilities.
- B. Additionally, as leisure activities using ultra-light air-vehicles get to be increased, it is required to enhance safety of low altitude air-vehicles. So the SSR transponder installation is mandatory for light aircrafts to communicate with ATC agents. And an alternative way is also required to reduce installation cost and to improve safety measure.
- C. For these reasons, in order to resolve the problems described above, we have planned to make the practical use of ADS-B in Korea. The planning study was executed in 2009. As a result of the study, the ADS-B surveillance system development project was started in 2010 in the way of gradual adaptation to the environment of Korea and its implementation plan was also established.

3.1.3 Scope of the ADS-B Surveillance system

3.1.3.1 The ADS-B system developed in Korea is composed of 5 elements as below

- A. ADS-B airborne Elements
- B. CDTI (Cockpit display of traffic information, PDA level)
- C. ADS-B Ground Stations
- D. ADS-B Monitoring Element
- E. ADS-B Server Element

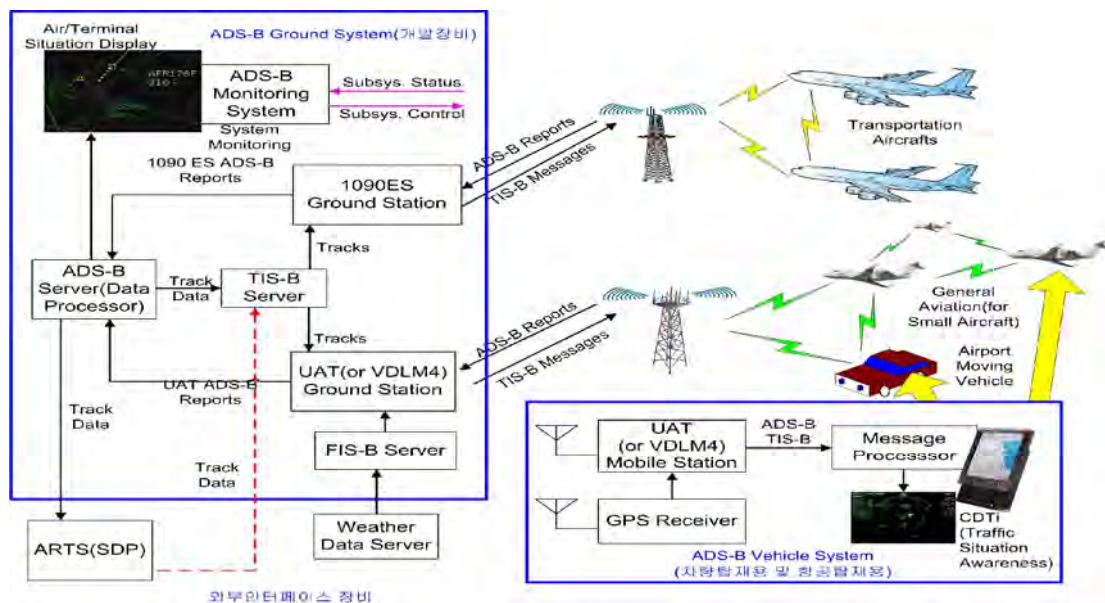


Fig 3. The building blocks of ADS-B system in Korea

3.1.3.2 All of 1090ES, UAT, VDL M4 are selected as the candidate medium of ADS-B data link. Ground Stations are considered to be developed as the type of multi-mode receiver to accommodate all the ADS-B data link technologies. The use of 1090ES technology is on the base and one of UAT and VDL M4 is to be selected as an additional technology according to global trend analysis in 2011.

### 3.1.4 Schedule of ADS-B R&D

- A. Phase 1 (2010-2011) : Development of ADS-B system, Implementation of Test and Evaluation environments
- B. Phase 2 (2012-2013) : Performance Improvement of air and ground surveillance
- C. Phase 3 (after 2014): Acquiring key technologies, deployment in the domestic area and regulation for installation of ADS-B airborne system.

## 3.2 Development of GBAS Technology

### 3.2.1 Summary of GBAS Navigation system

3.2.1.1 The 10th ICAO Air Navigation Meeting in September 1991 verified the benefit to cost advantage of GNSS navigation compared to conventional ground navigation facility (ILS, NDB, VOR, etc.) and concluded to use GNSS navigation as the standard system from 2010.

3.2.1.2 Many countries have tried to utilize GBAS technology, but there were many subjects to be improved and resolved. Especially, accuracy, safety and integrity are emerged as subjects to be resolved continuously.

3.2.1.3 Because the effect of ionosphere to the signal of GNSS satellites differs from location to location globally such as the equator, middle latitude, etc., each country has to strive for the implementation of GBAS. It means that each country should confirm the safety of GBAS with in-depth test and operation, and build up approval process, and then the system should be introduced successively considering the environment of airline's avionics.

### 3.2.2 Necessities of GBAS application in Korea

- A. Several airports in Korea cannot have bi-directional ILS system because Korean territory consists of 70% of mountain
- B. As the amount of air traffic increases, such airports need to be equipped with bi-directional ILS. To install ILS, some kind of actions should be carried out to meet glide slope angle, such as; partly cutting of mountain, diverting and/or extension of runway to residence zone. Considering the side effects of treatment, Korea seriously feel the necessity of introduction of GNSS navigation because it can mitigate side effects such as environmental damage, increase of noise in residence area and increase of national budget expense, etc.
- C. Therefore, to overcome limited air traffic capacity and to ensure safer and more efficient navigation service to GNSS avionics equipped airplanes, Korea gives positive consideration to GBAS. Korea will check safety of GBAS at Korean atmosphere through test and evaluation. And Korea will also establish approval processes (System, Facility and Operation Approval) at the government level based on the prototype implementation and test results.

### 3.2.3 Environment for GBAS Operational Technology Development

3.2.3.1 The followings are contents of the GBAS CAT-I project to be started from 2010

A. Prototype introduction and Government approval system development

Test airport establishment and Facility Approval

C. T&E and operation (evaluation of accuracy/integrity/continuity/availability)

D Maintenance and operation technologies and process development

3.2.3.2 The Figure 4 represents the operational environmental concept on GBAS CAT-I Test-Bed to be installed in the trial airport

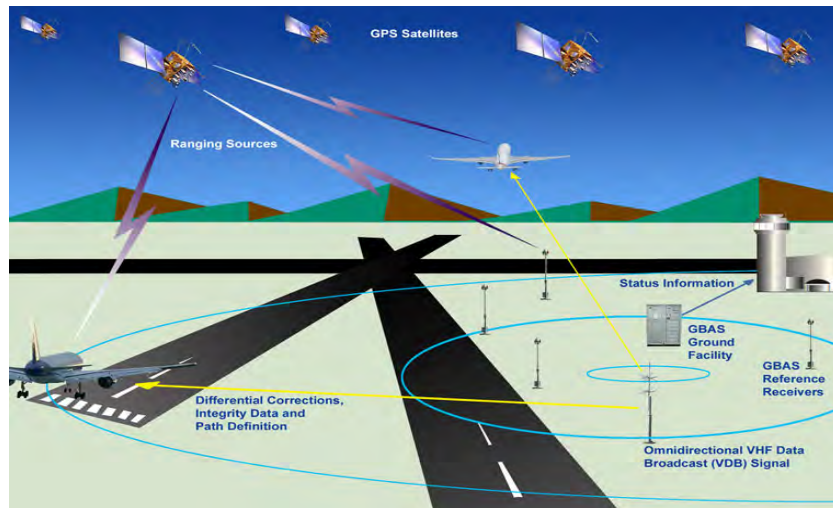


Fig. 4 GBAS Operational environment in a Test-bed Airport

3.2.3.3 To develop GBAS approval system and operational technology, aircraft which has GNSS avionics is required, also. However, since GBAS capable MMR equipped airplane is not available except the newly introduced airplanes such as A380, B777, etc. in Korea, test airport should be selected considering the possibility of flight of GBAS equipped airplanes.

3.2.3.4 For the technology development, somewhat qualified GBAS system will be utilized. The system will be installed in airport and performance evaluation in Korean environment will be carried out. Based on the result, approval process and system will be established.

3.2.3.5 Research Institutes and Universities of Korea have conducted basic researches since 2000. However, the introduction of GBAS system was delayed due to the international delay of the equipment's integrity and safety evaluation, creation of operational environment for both ground system and airplane.

3.2.3.6 Korea has been studied the effect of ionosphere by installing IMT system on Jeju Island which located nearest to the equator in Korea since 2007, however. Through the 1st stage development of GBAS operational technology (from 2010 to 2014), Korea will start to introduce GBAS which is suitable to the environment of Korea.

3.2.4 The development of the GBAS CAT-I operation technology

A. 1st Phase (2010-2011) : Certification system development, build a test-bed facility and select a test airport

B. 2nd Phase (2012-2013) : Ground and flight test, establish operation procedures and certification system

C. 3rd phase (2014~) : Basic research on equipment and service for GBAS CAT-II/III system

#### **4. FUTURE PLAN**

4.1 The ROK will implement the ADS-B and GBAS CAT-I system along with the ICAO transition plan with well adapted facilities to ROK environment.

4.2 The result of R&D will be applied to airplanes in the air and at airports after successfully finishing the projects in 2014.

4.3 The other R&D projects will be executed as planned and the status of Korean CNS/ATM researches will be updated at this meeting each time to share the information among member countries.

#### **5. ACTION BY THE MEETING**

The meeting is invited to:

a) note the information on R&D activities on ADS-B, GBAS described in this paper

b) comment on a good ideas to help all member to sharing information on R&D activities

-----