

**52ND CONFERENCE OF
DIRECTORS GENERAL OF CIVIL AVIATION
ASIA AND PACIFIC REGIONS**

*Manila, Philippines
26 – 30 October 2015*

AGENDA ITEM 3.3: AIR NAVIGATION MATTERS

**RESEARCH AND DEVELOPMENT STATUS OF ATM SYSTEM
IN JAPAN AND CONTRIBUTION TO HARMONIZATION IN
ASIA/PACIFIC REGION FOR FUTURE SKY**

(Presented by Japan)

INFORMATION PAPER

SUMMARY

In Japan, Electronic Navigation Research Institute (ENRI) is the only institute specializing in air traffic systems consisting of Air Traffic Management (ATM), Communication, Navigation and Surveillance (CNS). This paper reports how ENRI conducts research and development under close cooperation with Japan Civil Aviation Bureau (JCAB) and how the measures are realized, by showing examples which have been intensively and strategically conducted by ENRI. Furthermore this paper reports ENRI's approach of strengthening collaboration for reinforcement of institute.

RESEARCH AND DEVELOPMENT STATUS OF ATM SYSTEM IN JAPAN AND CONTRIBUTION TO HARMONIZATION IN ASIA/PACIFIC REGION FOR FUTURE SKY

1. INTRODUCTION

1.1 The demand of air transportation in the world has been expected to increase especially in Asia/Pacific Region. In Japan, major air traffic growth is also anticipated in the context of growing economic exchange between Japan and neighboring countries, operations of low cost carriers and Tokyo Olympic Games in 2020.

1.2 To appropriately cope with the future air traffic growth, it is indispensable to enhance air traffic system as the basis of infrastructure for air transportation. Thus, importance of Research and Development (R&D) for the air navigation fields has been growing.

1.3 Electronic Navigation Research Institute (ENRI) is the only institute in Japan specializing in air traffic systems consisting of Air Traffic Management (ATM), Communication, Navigation and Surveillance (CNS) and has conducted R&D to promote air traffic safety, efficiency and environmental preservation. ENRI conducts R&D under close cooperation with Japan Civil Aviation Bureau (JCAB) for realizing the measures. ENRI has carried out effective and efficient R&D projects in the circumstance of limited number of researchers, as well as promoted R&D collaborations with other research organizations such as air navigation service providers, universities, other research institutes and private enterprises in domestic and overseas.

2. DISCUSSION

2.1 Implementation of ENRI's R&D

ENRI conducts R&D and evaluation under close cooperation with JCAB, which is responsible for standard-setting, installation, and operation for air traffic system or air traffic control. It contributes for realization of needs from airlines or passengers such as improvement of operational effectiveness and quality of air transportation service. In recent years, ENRI has strategically focused on extremely important R&D projects, such as expanding of traffic volume and strengthening of functions at capital airports, and ensuring safety of air traffic.

2.2 Major research areas of ENRI's R&D

ENRI has strategically focused on R&D projects by categorizing into three themes as follow.

- a. Advanced flight operation
- b. Advanced operation on or close to airport
- c. Safety enhancement and technology connecting air and ground

Major outputs are as follow.

2.2.1 Research and Development on Advanced Flight Operation

ENRI is involved in a research project called "Study of Oceanic Route Optimization considering Arrival Route" from FY2012 to FY2015. An ATC simulator was developed which covers from oceanic routes to terminal routes as a part of the project. The simulator is capable of following functions;

- ◆ Computation of UPRs (User Preferred Routes) and DARP (Dynamic Airborne Reroute Procedure) routes
- ◆ ATC Simulations which accepts controller's input
- ◆ CDO (Continuous Descent Operations) simulations
- ◆ ATC Simulations based on different wind conditions between actual data and forecast data in the FMS (Flight Management System).

One of the outputs of the study is the evaluation of PACOTS (PACific Organized Track System) over north pacific airspace. Simulation results show that two straight eastbound oceanic routes could reduce 3 minutes of flight time and 1,000lbs of fuel consumption by branching to the south. This benefit is expected on 58% of days in a year and the routes are proposed for IPACG (Informal Pacific ATC Coordinating Group). One of the simulated routes was officially introduced in March 2013. In the past year, 89 flights that operated on the introduced route have obtained benefits, thus it has contributed to the stakeholders in Asia/Pacific Region.

2.2.2 Research and Development of advanced operation on or close to airport: Development of GBAS (Ground-based Augmentation System).

ENRI has been developing GBAS suitable for Japanese environment, which is summarized as safety design and validation to risks on GNSS signals affected by frequently-occurred ionospheric disturbances and siting restrictions due to compact airport in contrast with European countries and U.S. Regarding ionospheric disturbances, it is well known that a large spatial gradient in ionospheric delay significantly degrades GBAS performances. Japan is located in low magnetic latitude, where phenomenon of Equatorial anomaly is remarkable for generating background ionospheric gradients under nominal condition in spring and autumn. Additionally, plasma bubble, which produces large ionospheric gradients and significant scintillation on GNSS signals, is often occurred in such region and seasons. ENRI had proposed establishment of CNS-SG Ionospheric Studies Task Force (ISTF) to ICAO APANPIRG and has played an important role in the ISTF.

ENRI had developed a research prototype of CAT-I GBAS, which had been designed and validated to satisfy requirements of ICAO SARPs and RTCA documents except for software assurance and redundant hardware configuration, and had installed it in Kansai International Airport in 2011. From one-year field data, ENRI had optimized and validated GBAS parameters including integrity monitor performances. In cooperation with Boeing, All Nippon Airways (ANA) and Japan Airlines (JAL), ENRI successfully conducted GBAS approach demonstration using the research prototype with Boeing 787, which equipped airborne GBAS system as standard configuration.

In 2010, ICAO developed a baseline SARPs for CAT-III GBAS using a GPS L1 signal, which called as GBAS Approach Service Type D (GAST-D). Based on knowledge and experience of the CAT-I GBAS prototype development, ENRI develops technologies for safety design of GAST-D with consideration of risks under Japanese environment such as ionosphere anomaly. To achieve the purpose, ENRI has developed a research prototype of GAST-D ground subsystem for safety design and its validation since April 2011. The prototype has been installed in low magnetic latitude region in Japan (New Ishigaki Airport; 24.4N / 124.2E) for operational validation of the baseline GAST-D SARPs since February 2014. Purpose of this continuous operation of the prototype includes evaluations of fundamental functions and validations of integrity parameters under real environment, where plasma bubble is frequently occurred in spring and autumn. The GAST-D concept is designed to

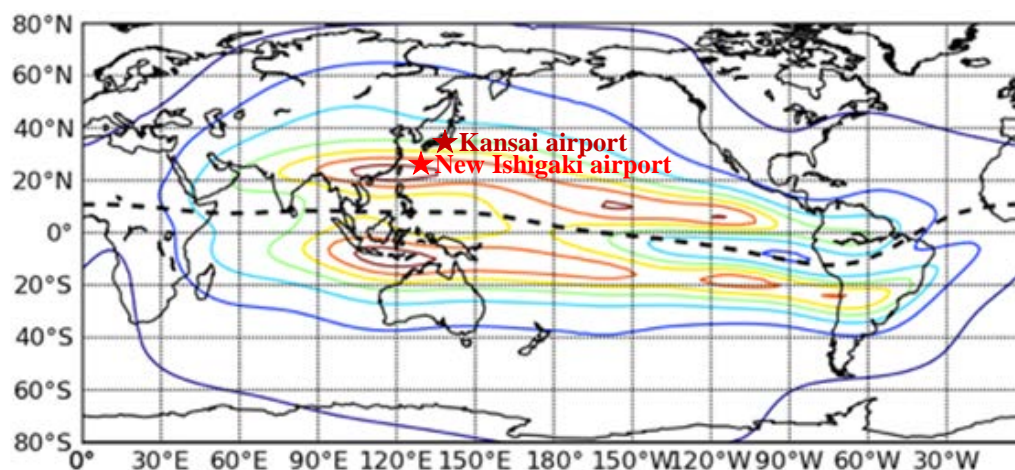


Figure 1. Airport location of GBAS R&D and ionospheric effect

mitigate ionospheric threat with both ground and airborne integrity monitors. Therefore, ENRI has also developed a GAST-D airborne experimental system equipped with the major airborne integrity monitors for GAST-D requirement and flight experiments has been performed in spring and autumn 2014. With these outputs of R&D, JCAB has a plan to install CAT-1 GBAS.

The results and ionospheric threat models obtained through ENRI's GAST-D validation activities include capabilities to be good solutions to applicable for other countries in Asia/Pacific Region. In addition, ENRI is working with ICAO APAC Regional Office for coordinated data collection, analysis and sharing to develop common ionospheric threat models in Asia/Pacific Region through the ISTF.

2.2.3 R&D for Technologies connecting air and ground and for safety enhancement: Evaluation Effectiveness of Transmitting-Portable Electronic Devices (T-PED).

The Transmitting-Portable Electronic Devices (T-PED) such as mobile phones, laptop computers with Wi-Fi and smart phones intentionally radiate electromagnetic waves. The possibility of the Electromagnetic Interferences (EMI) for the instruments of the aircrafts are not zero, because these T-PEDs generally transmits relatively strong electromagnetic fields compared with the conventional electronic devices with no wireless functions. The regulations limited the usage of these devices inside the aircraft cabins. On the other hand, there have been a lot of demands for the utilization of these T-PEDs inside the aircraft. ENRI has been conducted the research project on the Electromagnetic Compatibility (EMC) issues of the aircraft. This includes the experiments using many types of aircrafts and the theoretical investigation of the EMI occurrence mechanism due to the T-PEDs. These results are contributed to revise the regulation of the usage of the T-PEDs inside the aircrafts. As result, based on our research achievements, the T-PEDs are available in many flight situations which include in-fights conditions in Japan.

2.3 ENRI's approach for strengthening of collaboration

2.3.1 ENRI has been carrying out more than 40 research projects by about 60 researchers, and there are few research organizations dealing with issues about Air Traffic Management in Japan. Therefore, it carries out effective and efficient research and development projects in the circumstance of limited number of researchers, as well as it is also promoting research collaborations with other research organizations. ENRI currently is cooperating with 15 universities or research organizations in abroad include 3 Asian universities or research organizations. It is making effort to create excellent research results, produced by itself or by the cooperation with it and other organization, and promoting the expansion of these results.

2.3.2 In order to increase cooperation with research institutions in Asia/Pacific Region, ENRI has held the ATM/CNS seminars in the Asian countries since 2014. The seminars were held in Viet Nam and Malaysia in 2014, and held in Singapore in 2015. ENRI continues this activity, and makes effort to increase the research cooperation and personnel exchanges between research institutions in Asia, in order to conduct R&D projects that matches the situation of ATM in Asia/Pacific Region.

2.3.3 ENRI has organized ENRI International Workshop on ATM and CNS (EIWAC) since 2009, and it plans to hold the fourth conference in November this year (EIWAC2015). The participants will be researchers and engineers, who will come from US and Europe and Asia Pacific States. This effort contributes to such as development of human resource and international exchange of young of the academic field, toward the future. And, it makes activate the research and development in Asia/Pacific Region, and is going to contribute to progress the sophisticated ATM. EIWAC2015 will be held from 17 to 19 in November, this year. Its theme is "Global Harmonization for Future Sky". More information is attached as Appendix, and Detail information is on the website below:

<http://comm.stage.ac/eiwac2015/en/index.html>

3. ACTION BY THE CONFERENCE

3.1 The Conference is invited to:

- a) note the information contained in this Paper; and
- b) note the information for person who is interested in the 4th EIWAC.



Call For Participation EIWAC 2015

~ Global Harmonization for Future Sky ~

Date Nov.17(Tue.) – 19(Thu.) **Venue** KFC Hall & Rooms

Registration fee Free The workshop attendance will be free, including the coffee breaks.

Please visit the website www.eiwac2015.jp

Welcome

ENRI, a national laboratory in Japan conducting research and development on air navigation systems, is now organizing the fourth ENRI International Workshop on ATM/CNS (EIWAC2015). We are now calling for your participation to the EIWAC.

Air transport is now widely recognized as a key contributor to economic and social development. In order to maintain consistent air traffic growth in the world, continuous and harmonized safety improvement and modernization of air navigation systems must be taken into account.

The venue of the EIWAC 2015 will be Ryogoku where traditional and modern Japanese cultures meet. You can enjoy the atmosphere of the feudal age of Tokyo at Edo-Tokyo Museum and the latest pop culture in Akihabara which is about 2 km west from Ryogoku.

We cordially welcome you to EIWAC 2015. For further details of the EIWAC, please visit ENRI EIWAC website.

Venue : Ryogoku, Tokyo

The workshop venue is situated in the Ryogoku region, which is one of the historical areas in Tokyo. Ryogoku is a famous area in Tokyo because of the Kokugi-kan, the Sumo wrestling arena, the Edo-Tokyo museum, and several important places in Japanese history. Most of the historical places in Tokyo are easy to access from Ryogoku.



Access

Walking : 6min. from JR Ryogoku Station

Walking : 0min. from Oedo Subway Ryogoku Station A1

Secretariat Information

Tel. +81-3-5966-5782 / Fax. +81-3-5966-5773 /

E-mail: secretariat@eiwac2015.jp



Supporters



Scope

EIWAC 2015 is a conference in the area of Air Traffic Management (ATM) and its enabling technologies in Communication, Navigation and Surveillance (CNS). EIWAC 2015 includes presentations for both tracks of academic discussions and interchanges such as introductions of R & D activities, project updates and perspectives.

Topics

- Policy for Future ATM and Enablers
- Airspace Design
- Arrival Management
- Information Managements and Datalink
- Surveillance and D&A for UAS
- Human Engineering and Modelling
- Trajectory Based Operation
- ATM and Optimization
- ATM Modelling and Weather
- MIC Projects for New Technology
- Space weather, GNSS, SBAS and GBAS
- CNS Projects

Provisional Program

NOV. 17 (Tue.)	NOV. 18 (Wed.)	NOV. 19 (Thu.)
Opening Plenary Session (Keynote Addresses) -Standardization -R&D Projects -Operation Exhibition Reception (evening)	Invited Session Technical Sessions Asian R & D Exchange Exhibition	Technical Sessions Poster Session Exhibition Closing

Expected Guests in the Plenary and Invited Session

Edward Bolton (FAA), Blair Cowles (IATA), Christian Schleifer-Heingärtner (EUROCAE), Hitoshi Ishizaki (JCAB), Richard Macfarlane (ICAO), Philippe Merlo (EUROCONTROL), Neil Planzer (Boeing), Kiyoshi SAKURA (Mitsubishi Aircraft), Patrick Souchu (DSNA), Michael Standar (SESAR JU), Akbar Sultan (NASA), Kazuo Yamamoto (ENRI)

Selected papers

Adopted final papers in the Academic Track may be candidates for the Selected Papers from EIWAC 2015 which will be published as a book by Springer after the workshop. Please refer to the book of EIWAC 2013 in the site:
<http://link.springer.com/book/10.1007/978-4-431-54475-3>

