INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

REPORT OF

THE FIFTH MEETING OF IONOSPHERIC STUDIES TASK FORCE (ISTF/5)

Ishigaki, Okinawa, Japan

(16-18 February 2015)

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PART I – HISTORY OF THE MEETING

1. Introduction

1.1 The Fifth Meeting of Ionospheric Studies Task Force (ISTF/5) was held at the Hotel Nikko Yaeyama, Ishigaki, Okinawa, Japan from 16 to 18 February 2015.

1.2 The meeting was hosted by JCAB and ENRI organizations.

2. Attendance

2.1 The meeting was attended by 21 participants from 6 States (China, India, Japan, Malaysia, Thailand, USA), 1 Regional Organization (Eurocontrol) and 5 Industry organizations (Boeing, UK NATS, Honeywell, Indra Navia, Thales).

2.2 The session of the Meeting on 16 February afternoon (webconference) was attended by 24 Participants from 8 States (Australia, China, India, Japan, Malaysia, Philippines, Thailand, USA), 1 Regional Organization (Eurocontrol) and 4 Observers from Industry. A list of participants is provided at **Attachment 1.**

3. Opening of the Meeting

3.1 On behalf of Mr. Arun Mishra, the ICAO Regional Director, Mr. Frédéric LECAT, Regional Officer CNS of the ICAO Asia and Pacific Office, welcomed the participants to the meeting and expressed appreciation to the JCAB (Japan Civil Aviation Bureau) and Electronic Navigation Research Institute (ENRI) organizations for supporting the ICAO regional activities and hosting the meeting. He recalled the objective to deliver the regional mitigation threat models for SBAS and GBAS in the APAC region.

3.2 In his address, Dr. Susumu Saito, Chairman of the Task Force, welcomed the participants to the meeting. He explained that there would be a joint session with the Category II/III subgroup of the ICAO Navigation Systems Panel (ICAO NSP CSG) held on Tuesday, 17 February 2015. The technical tour to the GBAS Service Type D (GAST-D) prototype of ENRI at New Ishigaki Airport was conducted from 1330 to 1800 hours on Wednesday, 18 February 2015.

4. Officers and Secretariat

4.1 The ISTF meeting was chaired by Dr. Susumu Saito, Chairman of the Task Force. Mr. Frédéric LECAT, Regional Officer, ICAO APAC Office was the Secretary of the meeting.

4.2 The joint session between the ISTF 5th Meeting and the NSP CSG Meeting on the second day was moderated by Mr. Frédéric LECAT.

5. Working Arrangements, Language and Documentation

5.1 The ISTF met as a single body. The working language for the meeting was English inclusive of all documentation and this Report. The lists of Working/ Information Papers and Presentations are provided at **Attachment 2.**

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Agenda Item 1: Adoption of agenda

1.1 The agenda was reviewed and adopted as follows:

Agenda item 1: Adoption of agenda

Agenda item 2: Review of outcome of relevant meetings/conferences

Agenda item 3: Review of status of States' activities

Agenda item 4: Review of progress of tasks and related action items

a) Task 1 - Data Collection
b) Task 2 - Iono Analysis
c) Task 3 - TEC Generation
d) Task 4 - Scintillation Data
e) Task 5 - Iono Models
f) Task 6 - Space Weather

Agenda item 5: Joint session with ICAO NSP CSG

Agenda Item 6 Review of action items

Agenda Item 7 Any other business

Agenda item 8: Future plan

Agenda Item 2: Review of outcome of relevant meetings/conferences

WP/02 - Review of outcome of relevant Meetings/Conferences (Secretariat)

2.1 PBN is one of the regional priorities and targets established by APANPIRG 25 in 2014.

2.2 The meeting was informed about the ***Decision APANPIRG 25/44*** to establish the APANPIRG Performance-based Navigation Implementation Coordination Group (PBNICG). The first meeting PN ICG/1 will be held from 10 to 12 March 2015 in Beijing, China.

2.3 It was also explained that a PBN seminar would be organized from 08 to 10 June 2015 in ICAO premises in Bangkok. The ISTF work will be the focus of one of the presentations. All participants are invited to advertise the event and consider their participation in the event. The theme will be: ***Expanding PBN and Facing the Challenges in the Asia and Pacific Regions***.

2.4 The meeting was also informed of the Decision APANPIRG 25/1 to develop the new APAC eANP. The meeting was invited to consider developing draft specific requirements to the eANP if required, as a result of the assessment of the need for Regional GBAS and SBAS ionospheric models.

2.5 An APANPIRG Contributory Bodies Structure Review Task Force (ABSRTF) will be established in 2015 under APANPIRG ***Decision 25/50*** and may propose to APANPIRG/26 to change the PIRG structure and TOR of ISTF. The main drivers for this TF are to rationalize the APANPIRG structure to meet the changing environment to APANPIRG/26 and generalize the project management principles in all bodies.

Agenda Item 3: Review of status of States' activities

IP/02 - GNSS IMPLEMENTATION IN INDIA: ACTIVITIES AND STATUS UPDATE (India)

3.1 This paper presents the activities and status update on GNSS implementation for navigation over Indian Region including GAGAN and GBAS. It also highlights the Operational Test & Evaluation (OT&E) tools developed by AAI, GAGAN team. GAGAN was certified for RNP0.1 service in December 2013 and consequently declared commissioned for RNP0.1 to support for en route operations on 14th February 2014. India informed the meeting that the work on certification for APV1 service is being carried out and is likely to be completed by second quarter of 2015. OT&E is an essential component of the approval process.

3.2 Some of the sample plots were produced by Range Error Bounding Tool, UDRE. India explained that the samples show that various range residual errors generated after applying GAGAN corrections are well bounded by their respective integrity bounds broadcast by GAGAN thus adequately meeting the integrity requirement.

IP/04 - Status of ionosphere studies in GNSS implementation in China (China)

3.3 IP/04 presents the ionosphere studies on GNSS implementation in civil aviation in China. Long term variations, ionosphere anomaly, and proposed program were analyzed.

3.4 China informed the meeting that GRIMS (Ground Regional Integrity Monitoring System) has been established since 2004 to promote GNSS's integrity. Ionosphere studies from GRIMS raw data is one of important aspects of system evaluation. Besides GRIMS raw data, data from seven IGS sites in China and simulated data have been utilized to analyze the performance of various augmentation systems proposed by industry. The seven stations are currently deployed and cover most part of China. A ground based augmentation system (GBAS) has been installed in Shanghai Pudong Airport. Performance evaluation and flight inspection will be planned.

Other States

3.5 ENRI is currently performing analysis of data. MSAS has been certified for NPA, and Japan has currently no plans for further certification.

3.6 Aerothai plans GBAS implementation for 2017 or 2018, depending also on the results of this task force. Aerothai plans to procure 2 scintillation receivers at Suvarnabhumi airport.

3.7 United States informed the meeting that the focus was on the validation of GAST-D requirements and work with the LTIAM tool.

Agenda Item 4: Review of progress of tasks and related action items

a/ Task 1 - Data Collection

Review of activities since the last meeting

3.8 Data were collected from Philippines, India, Singapore and Hong Kong china. During the meeting, data from Thailand were handed over to ENRI. Australia has provided the ftp information, but has not yet been transferred onto the ISTF data server.

WP/06 - AATR ANALYSIS TOOLS AND CURRENT STATUS OF ANALYSIS OF ISTF DATA

3.9 WP/06 introduces AATR (Along-arc TEC rate) analysis tools developed for ISTF data analysis. AATR can be derived from data in RINEX, GTEX, or GAGAN-TEC (ASCII records of GISTM receiver) among the data contributed to ISTF. The status is as follows:

- A converter from RINEX data to AATR (rinex2aatr) is available
- A converter from GAGAN-TEC data to AATR (ismra2aatr) is also available
- A converter from GTEX data to AATR is under development.

3.10 AATR generation toolkit was adopted as a standard tool of ISTF.

3.11 Japan informed the meeting about the current status of AATR analysis of ISTF data:

Contribution by	Data Period	Data Format	Analysis Status
India	Mar., Jun., Sep., Dec., 2004 Mar., Jun., Sep., Dec., 2008 Mar., Jun., Sep., Dec., 2012	GAGAN-TEC	AATR generation being done by India
Japan	TBD	RINEX/GTEX	To be transferred to ISTF server
Hong Kong	Land Department; Oct. 2000 – Dec. 2009 01 Oct 2012 HKIA: Jul. 2010 – Aug. 2013	 NovAtel Binary RINEX RINEX	 Being converted to RINEX - AATR generation in progress
Philippines	20081011 20100405 20100803 20100804 20110528 20110605 20110805 20110806 20110926 20111024 20111025 20120309 20120312 20120315 20120424 20120616 20120709 20120715 20120716 20121001 20121008 20121009 20130317 20130601 20130629 20131002	GTEX0.1	GTEX to AATR conversion tool under development

Contribution by	Data Period	Data Format	Analysis Status
Singapore	13-27 Mar. 2013 01 Jun. 2013 02 Oct. 2013 16-30 Sep. 2013 22-29 Oct. 2014	RINEX	AATR being generated
Thailand	VTBS: 2011-2013 VTCC: 2012-2013 VTPP: 2013 VTSB: 2009-2013 VTSS: 2010-2013	NovAtel Binary	Being converted to RINEX
APEC GIT	Jul. 2006 – Jan. 2007	APEC GIT specific binary	To be decoded by MATLAB program provided by APEC GIT

IP/03 - GTEX tool status (NICT)

3.12 IP/03 presents the guidelines about how to generate data in GTEX format from GNSS receiver data in RINEX format in response to the Action Item 4/2 identified by the fourth meeting of the Ionospheric Studies Task Force (ISTF/4). Action item 4/2 was closed.

3.13 The meeting discussed that such guidance material would be also beneficial for GTEX format.

Action 5/1: to prepare guidance material for GTEX format (Mamoru Ishii, NICT)

b/ Task 2 - Iono Analysis

WP/02 - DEVELOPMENT, TESTING AND VERIFICATION OFAATR GENERATION TOOLS AND RESULTS OF AATR ANALYSIS OVER INDIAN REGION (India)

3.14 India explained that the AATR (Along-Arc TEC Rate) parameter identifies the regional irregularity and would be useful for data mining by all associated ISTF member states. India in collaboration with Japan and Australia explained the process adopted for testing and verification of AATR generation tools developed independently by Japan and India and recommended ISTF to examine the methodology for testing and verification and the results of AATR tool for its use in regional Ionospheric work.

3.15 India has generated the AATR from the GAGAN-TEC data for the year 2004, 2008 and 2012 and has analysed the data. The extreme dates have been identified for each year and for each receiver of GAGAN-TEC network and are provided as attachment- Appendix A with the paper. Since the extreme conditions are rare in nature, the 99.7^{th} percentile of AATR is also estimated and provided in the Appendix A.

3.16 India pointed out some issues in AATR generation related to spikes and surges in AATR values. These spikes may add up or hike the RMS values thus giving false information. The meeting discussed that these spikes may be due to cycle slips and shall be handled before AATR generation. Hence the action item was generated.

Action 5/2: to modify AATR tool to handle cycle slips and irregular data (Susumu Saito, 13 March 15)

WP04/ - EXTREME IONOSPHERIC DELAY GRADIENT (Japan)

3.17 An extreme ionospheric gradient of 518 mm/km observed in a plasma bubble event on 3 April 2008 at Ishigaki, Japan was further investigated by using dual-frequency data. Dual-frequency ionospheric delay difference results support the plausibility of the large gradient. Wavefront direction and velocity were estimated by using temporal variation patterns of ionospheric delay.

- Eastward velocity: 105 m/s
- Wavefront normal direction is consistent with the direction of gradient
- Spatial scale: 6.3 km - Reconstructed gradient: 380 mm/km (1 min average)

3.18 The ionospheric gradient of 518 mm/km observed in a plasma bubble event on 3 April 2008 at Ishigaki, Japan is quite plausible.

3.19 After review of WP02 and WP04, the meeting agreed that the AATR parameter can be used to locate ionospheric events. The meeting considered both analysis methodologies as candidate methods to derive GBAS ionospheric threat model.

3.20 LTIAM uses dual frequency TEC and has an inter-frequency bias, this bias being estimated, while ENRI's method is based on estimates using one single frequency. This method can be free from bias.

WP/05 - IONOSPHERIC DELAY GRADIENT ANALYSIS WITH THE SINGLE-FREQUENCY CARRIER-BASED AND CODE AIDED METHOD (Japan)

3.21 ENRI developed a method to estimate ionospheric delay differences between two GNSS receivers based on single-frequency carrier-phase and code measurements, which is called "single-frequency carrier-based and code-aided (SF-CPCA) method. This method was proposed to be one of the methods of ISTF data analysis to derive ionospheric delay gradients. The meeting noted the requirements to the accuracy of relative positions of a pair of GNSS receiver antennas to derive ionospheric delay gradients with the SF- CPCA method.

3.22 Performance of the SC-CPCA method was tested with the data from the GBAS reference receivers installed at the New Ishigaki Airport. The ratio of epochs when fixed solutions were obtained to all the epochs (fix rates) were compared for different position errors artificially added to the well-surveyed positions. It was found that relative position accuracy of 1.5 cm is required to obtain fix rates greater than 95 %.

SP/04 - GIMA (GBAS Iono Monitoring Assessment), Eurocontrol

3.23 Eurocontrol reported about their programme GBAS Iono Monitoring Assessment that is composed of Data selection, RINEX processing, automatic gradient screening and selection, Validation and Gradient validation. LTIAM was significantly modified with additional steps of processing introduced: development of a Human Machine Interface, new cycle slip (CS) correction algorithm, process all data independently from Kp or Dst, parallel computing, robustness improvement (exception handling), etc. LTIAM tool has been used by Eurocontrol for SBAS and GBAS since mid-2012. 2 years of data were processed from 7 European sites, and monitoring will be performed until mid-2016, based on the current program scope. A list of potentially iono gradient threats (station pair, PRN, date, maximum gradient, elevation angle), gradient speed of selected gradients and eventually the iono mitigation models are the expected outcomes. A gradient is identified as a potential threat if the phase gradient and combined weighted gradients exceed 50 mm/km and both phase and CMC data are available. The new cycle slip correction implemented

decreased significantly the number of false gradient detected. A high number of potential iono gradients were identified, losses of lock were excluded and further work was be needed to select the cases to investigate as not all could be processed manually. Eurocontrol explained that so far very few iono gradients were identified in the Canaries Islands.

SP/01 - Introduction to LTIAM tool (SP01, USA)

3.24 A long-term ionospheric anomaly monitoring (LTIAM) was needed by USA to build an Ionospheric threat model, monitor ionospheric anomalies over the system life cycle, verify CAT I threat model, and trigger updates if needed. The LTIAM tool was borne.

3.25 The version 2.1 was made available to IGWG participating members in 2012. The other current LTIAM users: are USA and Eurocontrol. The same version of the tool and supporting documents are made available to the ISTF group members once an approval from FAA is obtained: LTIAM user manual, LTIAM Algorithm Description Doc v2.1, LTIAM-2.1 (zip file)

3.26 An application form for LTIAM software package was introduced. States or organizations not attending the meeting need to send an email to flecat@icao.int to get the application form.

3.27 Based on Eurocontrol's, India's and USA's feedback, for ISTF purpose, the search events module should be turned off.

c/ Task 3 - TEC Generation
Nil

d/ Task 4 - Scintillation Data
Nil

e) Task 5 - Iono Models

WP/07 - SBAS threat model (ENRI)

3.28 A brief explanation of the ionosphere threat model developed for WAAS/MSAS to enhance development of threat models for Equatorial Regions was introduced. Each SBAS provider needs to develop ionosphere threat model applicable within its service volume based on observation data in past and/or some ionosphere disturbance models. Augmentation systems need to generate ionospheric corrections: fitting into the message structure defined by SARPS; accurate enough to improve position accuracy; and meeting integrity requirements.

3.29 Japan's experience is that the major concern for vertical guidance is ionospheric anomalies. En-route thru NPA modes is available at the whole Fukuoka FIR. APV-I is not always available: 95% at the center of Japan and less than 50% at Okinawa islands (Including Ishigaki Island) because of large protection levels due to the large uncertainty of ionospheric errors: the ionospheric term (GIVE, grid ionosphere vertical error) is the dominant component of the Vertical Protection Level. The availability of vertical guidance of MSAS is therefore lowered by the ionospheric term.

3.30 For SBAS, ionosphere propagation delay must always be overbounded by GIVE information broadcast along with vertical delay.

3.31 The objective set by the TOR of ISTF is the development of Regional Ionospheric Threat Models for SBAS if the need is identified. The meeting confirmed that the need is identified. The Task Force needs to develop SBAS ionosphere models including spatial and temporal threat representations acceptable for participating States/Regions.

3.32 With regard to the terms of reference to "develop SBAS ionosphere models including spatial and temporal threat representations acceptable for participating States/Regions" and due to the different distributions of ground networks and other factors, the model cannot be common for SBAS. The common part could be about the methodology. The same methodology using data deprivation can be applied for all SBAS threat model. A guidance material is needed for the safety case for using SBAS services in the APAC region: how to mitigate operational hazards related to the ionospheric threats.

3.33 The meeting identified therefore 6 steps to complete the Task 5 for SBAS:

1. Identify the operational hazards related to the ionospheric threats for SBAS;

2. Identify factors influencing the mitigation strategy (ground stations distribution, iono model used, etc.);

3. Identify common threats (independent of any particular iono model) such as temporal and spatial threats;

4. Identify requirements for the threat model (such as: level of overbounding of ionospheric errors);

5. Develop a methodology to generate threat mitigation models;

6. Optionally, develop a tool for generating the threat model; and

3.34 Steps 1 and 2 should start immediately. Following actions were raised:

Action 5/3, Dr. Sakai, due date 09 June 15 : Identify operational hazards related to the ionospheric threats

Action 5/4, Dr. Sakai, due date, 09 June 15 Identify factors influencing the mitigation strategy (ground stations distribution, iono model used, etc)

Action 5/5, Dr. Sakai, due date 09 June 15: Develop the structure of guidance material

WP/08 - GBAS threat model (ENRI)

3.35 This paper introduced briefly the ionosphere threat model for GBAS (Ground-based Augmentation System). There are two kinds of ionospheric effects on GBAS. The first is ionospheric delay spatial gradient, which sometimes produces significant ranging errors. As the second, scintillation effect reduces available ranging source through loss of lock in signal tracking. It could reduce GBAS availability. GBAS messages are designed to mitigate effects of ionospheric spatial gradient under nominal conditions. However, it is required to detect and exclude anomalous ranging sources with unacceptable error under abnormal ionospheric conditions.

3.36 Threat model describes characteristics of the ionosphere from a view point of risks and defines the range of parameters that should be taken into account in designing a GBAS. It is needed to develop ionosphere threat model(s) considering dominant ionospheric phenomena in each region (SED, plasma bubbles, nominal conditions).

- Nominal condition: GBAS broadcast parameter of evaluation for remained ionospheric error (σ iono);

- Abnormal condition: Detect and exclude affected ranging sources; and

- Ionospheric phenomena: SED and Plasma bubble

3.37 The meeting discussed that there would probably be 2 sets of parameters for the APAC region for GBAS. A magnetic latitude would be used to segregate the areas of application of the models. The States would use this criterion to determine which model to use.

3.38 Prediction activities are not in the scope of ISTF, but the probability of gradients will be estimated.

3.39 The meeting identified 5 steps to complete the Task 5 for GBAS:

Using the draft GAST D SARPS guidance as a reference,

1. Identify the operational hazards related to the ionospheric threats for GBAS;

2. Identify factors influencing the mitigation strategy for GBAS in addition to parameters referenced in the GBAS related SARPS guidance material (such as occurrence probability, number of simultaneously influenced satellites, etc.)

3. Summarizing the iono characteristics of the APAC region (SED, plasma bubbles, optionally nominal ionosphere) for 2 sets of parameters in the APAC region;

4. Recommend/develop tool(s) for generating the threat model; and

5. Develop a methodology to generate the threat model.

The meeting agreed that Dr. Yoshihara, Task Lead/Task-5 for GBAS would be responsible for conducting the 5 steps.

GBAS Brazilian Ionospheric Threat Model Project (SP/02, USA)

3.40 Ionospheric activity in equatorial regions (within 25 degrees latitude of the geomagnetic equator) is known to be significantly more variable and more intense than what is encountered in mid-latitude regions such as CONUS. The goal was to develop a new model for Brazil.

3.41 The threat points were identified with the LTIAM tool. A second phase of validation was however needed to those that are actual ionospheric events. The comprehensive analysis supports that multiple satellite-station pairs were impacted by the same EPB in different times and locations. Extreme ionospheric gradient candidate of interest were finally validated to be real. Gradients above 500 mm/km should be validated using the proposed methodology while developing an ionospheric anomaly threat model for GBAS operation in the Brazilian region.

Chennai GPS Iono Data Analysis (SP/03, Honeywell)

3.42 The meeting was informed about the Chennai GPS Iono Data Analysis, showing gradients up to 311 mm/km.

3.43 The meeting established the following draft decision:

Draft Decision 5/1 - Need for ionospheric threat models in the APAC region

That, considering that extreme ionospheric gradients were observed in the APAC region through data collection, and in Brazil likewise, the need for GBAS threat model is confirmed**.** Considering the various factors such as variable ground stations network layouts and service levels, guidance for establishing a SBAS iono safety case model is needed**.**

f/ Task 6 - Space Weather

Space Weather Report about discussions in the MET group (SP/06, Japan)

3.44 An update on Task 6 -Space Weather was made by Japan. ISTF/4 discussed that the influence of equatorial event should be more emphasized in the draft ConOps. Consequently, during IAVWOPSG/8 in February 2014, IFALPA and Japan on behalf of the Asia-Pacific Ionospheric Studies Task Force provided the group with additional comments and information that were duly noted. During the ICAO/Met divisional meeting held in July 2014 the number of centres that would provide space weather information services serving international air navigation was discussed. Global centres could inform about solar radiation storms and solar flares, as well as for geomagnetic storms and ionospheric disturbances at the predictive stage and be augmented by an optimal number of regional centres for geomagnetic storms and ionospheric disturbances at the observation stage. There was an agreement that the optimal organization along with the roles, requirements and capabilities should be determined only after having clarified the service requirements and capabilities.

Agenda Item 5: Joint session with ICAO NSP CSG (1 hour)

➢ *ISTF opines that there should be mitigation of iono effects for SBAS and GBAS, what are CSG views concerning GBAS system?*

3.45 CSG views are that this effort was undertaken 15 years ago with GAST-C, and it is felt necessary to mitigate iono effects. The question is rather how, and what additional mitigation beyond basic standard, based on regional threat characterization, should be implemented.

3.46 It was discussed that it would be more efficient to have models adapted to low/mid/high latitudes. There should be no or few impact on avionics.

➢ *How manufacturers see the need for and the feasibility to implement iono mitigation models*

3.47 In-service experience data, stored by recording capabilities on the ground would contribute efficiently to the safety cases. A guidance material for that purpose would be helpful.

3.48 From the manufacturers' perspective, a threat model of GBAS is needed. The threat model could be incorporated in the guidance material for GAST. It should be compatible with the GAST-D interface as much as possible.

3.49 Different models would be created for SBAS and GBAS. However a common methodology (for data to be collected and analyzed) would be helpful and harmonization through ICAO regions could be needed at a later stage.

3.50 Vigilance activities and keeping the models valid would need a longer term commitment. It was suggested that the prediction of ionospheric gradients/losses of lock could be part of the user requirements for the future space weather services. An initial coordination with IAVWOPSG could take place under Task 6 of ISTF.

Agenda Item 6: Review of action items

3.51 The action table was reviewed and updated as per **Appendix A.**

Agenda Item 7: Any other business

Nil

Agenda Item 8: Future plan

3.52 The next webconference will be held on 19 June 2015, 11 a.m. UTC+7. More webconferences will be planned before the Face to Face meeting.

3.53 The next face to face meeting will be held tentatively in January 2016, Bangkok.

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Action Item	Action	Owner	Contributors	Target date	Status	Result	Comment
ACTION ITEM 2/1	To develop a guidance material on collection of scintillation data at strategic locations. Preliminary draft of the guidance material should be available by November 2012 and the finalized guidance material, incorporating all the recommended changes, should be available by December 2012	Task 1 Leader		Dec-12	Closed	Guidance material	Based on Hong Kong Satellite Positioning Reference Station Network and adopted as the guidance material and sample MOU for States
ACTION ITEM 2/2	Secretary to communicate with the APEC GIT Co-chairs regarding the data sharing template. Target date for receiving information from APEC GIT is end of December 2012.	ICAO Secretary		Dec-12	Closed	Information from APEC received	
ACTION ITEM 2/3	to coordinate with IGWG Iono Group to acquire LTIAM Tool. Target date is by the end of December 2012.	Task Lead, Task – 2		Dec-12	Closed		7 feb. 14: approval from FAA is pending Sep. 14 ROK contacted FAA again, with no result.
ACTION ITEM 2/4:	categorize the ionospheric delay measurements and scintillation measurements into geographical region to confirm an even spread of all the observation sites in the region. Target date for the Action Item was agreed as January 2013.	Task 1 Leader		Jan-13	Closed	WP ISTF 3	
ACTION ITEM 2/5	to prepare a mechanism to identify the terms of use of data as proposed by the data source and incorporate that in the data processing. Target date for this Action Item is January 2013.	Task 1 Leader		Jan-13	Closed	Data server interface was implemented	
ACTION ITEM 2/6a	a) Setting up of Server – Japan (January 2013)	Japan		Jan-13	Closed	Server at ENRI up and running	Data server sponsored by ENRI should need to be ready to receive/compile the data. Period of analysis could start from discussing which key parameters could be used for identifying such periods. States like India and Japan, which have already carried out some level of analysis, are requested to suggest these periods/parameters based on their experience. Data formats need to be reviewed and updated for their applicability for the purpose of analysis:
ACTION ITEM 2/6b	b) Finalizing data format – Japan (January 2013)	Japan		Jan-13	Closed		Refer to action item 3/1
ACTION ITEM 2/6c	c) Key parameters to categorize data – Republic of Korea – (January 2013)	Republic of Korea		Jan-13	Closed	ISTF/3 IP/7 was presented by ROK	Closed in ISTF/3
ACTION ITEM 3/1	Japan to coordinate with the Chairman of ITU-R WP-3L for the formats of scintillation data with the same name “SCINTEX” to have a unified format.	Task 1 Leader and Dr. Tsugawa			Closed		Closed 6 Feb. 14. Refer to Action 4/3
ACTION ITEM 3/2	to coordinate with FAA for obtaining permission to use the LTIAM tool by ISTF.	- Task Lead, Task-2 and Prof. Lee, ROK			Closed		Duplicated action

Action Item	Action	Owner	Contributors	Target date	Status	Result	Comment
ACTION ITEM3/3	to set up the data server for data sharing according to the outcome of ISTF/3 and prepare a manual for the use of the data server including keeping logs for accessing the restricted data	Task 1 Leader			Closed	setup of the ISTF data server for data sharing and exchange by Japan	
ACTION ITEM 3/4	to identify the past periods of interest for data Analysis	Task 2 Leader			Closed	dates of interest documented into a file with MS-excel format	Closed 6 Feb. 14
ACTION ITEM 3/5	- Secretary to issue a letter to India (Airport Authority of India) requesting the use of GAGAN-TEC data.	ICAO Secretary			Closed	Letter received	
ACTION ITEM 4/1	to check whether and under which conditions Septentrio data could be shared within ISTF	Australia		31-Aug-14	Open		Australia has to check the status of the project
ACTION ITEM 4/2	To develop guidelines about how to generate data in GTEX	Task 1 Leader		31-Oct-14	Closed	16 Feb.15 User Guide of RNX2GTEX for Linux/Unix (ver 1.1.3) User Guide of RNX2GTEX for Windows (ver 2.1)	Delayed, due to rotation of Dr. Tsukawa. GTEX format: end of Oct .14 Significant amount of data are available in Raw/RINEX data
ACTION ITEM 4/3	To finalize SCINTEX format with ITU by email	Dr. Tsukawa, Japan		30-Jun-14	Closed		In progress through emails and F2F - Final agreement to take place, depending on ESA side Document completed and sent to IGS meeting - Mamoru Ishii to send F.Lecat
ACTION ITEM 4/4	To provide the dates relevant for data Analysis relating to equatorial ionospheric anomalies	all participants		31-Mar-14	Closed	16Feb15 Data were collected from Philippines, India, Singapore and Hong Kong china. During the meeting data from Thailand were handed over to ENRI. Australia has provided the ftp information, but has not yet been transferred onto the ISTF data server	Closed for India on 24 June 14, which has proposed an approach based on 2delta/2sigma data mining for selecting the dates of interest. Dates are proposed in Excel spreadsheet. 16-Sep.-14: However thanks to AATR method, data analysis can proceed.
ACTION ITEM 4/5	identify which tools to use for data conversion to the common format RINEX.	Task 3 Leader	Australia, India, Japan	7-Mar-14	Closed	Tools selected: TEQC, RTKLIB, which should cover 99% of the needs	
ACTION ITEM 4/6	For LTIAM and ENRI's tools, identify how manual verification will be conducted	Task 3 Leader	Australia, India, Japan	31-Oct-14	Open		In progress - 16 Sep. 14 - postponed to 31 Oct. 14
ACTION ITEM 4/7	identify the need for ROTI to be included as one of the parameters for scintillation analysis	Task 3 Leader	Australia, India, Japan	31-Mar-14	Closed	ROTI can be included as one of the survey parameters	Republic of Korea may join the contributors
ACTION ITEM 4/8	ISTF Participants to send comments about Space weather draft Conops document to Secretary and Secretary to coordinate with IAVWOPSG.	all participants	Secretariat ICAO	14-Feb-14	Closed	Japan introduced to IAVWOPSG the importance of local ionospheric events for navigation, and will attend ICAO MET Div meeting in July 14, with an IP.	The IP will be shared with ISTF participants
ACTION ITEM 4/9	to confirm if/when there will be a joint session with NSP CSG about ISTF outcomes and way forward to implement mitgiation models in the GBAS system	Dr. Saito		15-Oct-14	Closed	Yes joint session on 17Feb.15	
ACTION ITEM 4/10	to coordinate data transfer from Singapore to the ISTF server	Dr. Saito		15-Oct-14	Closed	Data delivered by Singapore	
ACTION ITEM 4/11	collect available information on ionospheric threat definition on SBAS and GBAS systems about EGNOS with ESA	Dr. Surendra Sunda		12-Dec-14	Closed	No paper about EGNOS available in the public domain	

Action Item	Action	Owner	Contributors	Target date	Status	Result	Comment
ACTION ITEM 4/12	collect available information on ionospheric threat definition on SBAS and GBAS systems about WAAS and MSAS	Dr. Saito		12-Dec-14	Closed	3 or 4 papers identified and shared during webconference #3	
ACTION ITEM 5/1	to prepare guidance material for GTEX format	Dr. Mamoru Ishii		10-Jun-15	Open		
ACTION ITEM 5/2	to modify AATR tool to handle cycle slips and irregular data	Dr. Saito		13-Mar-15	Open		
ACTION ITEM 5/3	to identify operational hazards related to the ionospheric threats	Dr. Sakai		12-Jun-15	Open		
ACTION ITEM 5/4	to identify factors influencing the mitigation strategy (ground stations distribution, iono model used, etc)	Dr. Sakai		12-Jun-15	Open		
ACTION ITEM 5/5	Develop the structure of guidance material for SBAS	Dr. Sakai		12-Jun-15	Open		
ACTION ITEM 5/5	actions on GBAS	Dr. Yoshihara		12-Jun-15	Open		
ACTION ITEM 5/5		Dr. Yoshihara		12-Jun-15	Open		
ACTION ITEM 5/5		Dr. Yoshihara		12-Jun-15	Open		

Fifth Meeting of Ionospheric Studies Task Force (ISTF/5)

Ishikaki, Japan
16 – 18 February 2015

Attachment 1 to the Report

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Web Conference on
(16 February 2015 - afternoon)

AUSTRALIA
- Mr. Mike Terkildsen

PHILIPPINES
- Mr. Gary Jadie
- Mr. Joferand Torrefranca

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International Civil Aviation Organization

THE FIFTH MEETING OF IONOSPHERIC STUDIES TASK FORCE (ISTF/5)

Okinawa, Japan, 16 – 18 February, 2015

LIST OF WORKING/INFORMATION PAPERS

WP/IP PPT No.	Agenda Item	Subject	Presented by
		LIST OF WORKING PAPERS	
WP/1	-	Provisional Agenda	Secretariat
WP/2	2	Review of Outcome of Relevant Meeting/Conferences	Secretariat
WP/3	3	Development, Testing and Verification of AATR Generations Tools and Results of AATR Analysis over Indian Region	India
WP/4	4 (b)	Extreme Ionospheric Delay Gradient Associated with Plasma Bubble	Japan
WP/5	4(b)	Ionospheric Delay Gradient Analysis with the Single-Frequency Carrier-based and Code Aided Method	Japan
WP/6	4 (b)	AATR Analysis Tools and Current Status of Analysis of ISTF Data	Japan
WP/7	4	Ionosphere Threat Model for SBAS	Japan
WP/8	4 (e)	Ionosphere Threat Model for GBAS	Japan
WP/9	4 (b)	Review of Activities since the last meeting (ISTF/4)	Chairman of ISTF
		LIST OF INFORMATION PAPERS	
IP/1	-	Meeting Bulletin	Secretariat
IP/2	3	GNSS Implementation in India : Activities and Status Update	India
IP/3	4 (b)	Guidelines of GTEX Data Generation	Japan
IP/4	3	Status of ionosphere studies in GNSS implementation in China	China

WP/IP PPT No.	Agenda Item	Subject	Presented by
		LIST OF PRESENTATIONS	
SP/01	4 (b)	Long-term Ionospheric Anomaly Monitor (LTIAM) - Overview	USA
SP/02	4 (b)	GBAS Brazilian Ionospheric Threat Model Project: New Verification Methodology of Ionospheric Gradients Observed in the Brazilian Region	USA
SP/03	4 (e)	Chennai GPS Iono Data Analysis	Honeywell
SP/04	4 (b)	GBAS Iono Monitoring Assessment (GIMA)	Eurocontrol
SP/05	2	Space Weather Report about discussions in the MET Group	Japan

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