International Civil Aviation Organization

ACAC/ICAO MID WORKSHOP ON GNSS

Golden Tulip Farah Hotel (Rabat-Morocco)

SUMMARY OF DISCUSSIONS

I. GENERAL

1.1 Place and Duration

1.1.1 The ACAC/ICAO MID Workshop on GNSS with the support of EC, was successfully held at Golden Tulip Farah Hotel, Rabat, Morocco, 5 April 2016.

1.1 Opening

1.2.1 The Workshop was opened by his Excellency Eng. Mohamed Ibrahim Sherif, CEO of ACAC and Mr. Raza Gulam, Regional Officer CNS, ICAO Middle East Regional Office.

1.2 Attendance

1.2.1 The Workshop was attended by a total of forty (40) participants, from ten (10) States, three (3) Organizations and two (2) Industries. The list of participants is at **Attachment A**.

1.3 Agenda

I.3.1 The Agenda was developed around the main following topics:

a) Session 1: Global Provision and Regional perspectives on GNSS
b) Session 2: Regional SBAS: EGNOS and GAGAN
c) Session 3: Technological developments
d) Session 4: Conclusion and closing Session

I.3.2 The Work Programme is at **Attachment B.**

II. WORKSHOP OBJECTIVES

2.1 The main objectives of the Workshop were to:

- provide the latest developments related to GNSS SARPs, including the Status of core constellation and the different Augmentation Systems and their uses;
- increase awareness on the MID Air Navigation Strategy and the MID Region PBN implementation plan;
- recognise the importance of establishing an appropriate institutional framework for the provision of the network functions, and collaborative decision making process;
- increase know how of the African experience related to the GNSS initiatives in aeronautical domain;
- keep informed on the new EGNOS status and roadmaps;
- awareness of some projects launched by European Commission to support the EGNOS extension to tiers Countries;
- draw the ACAC GNSS roadmap (Euromed and Peninsula Countries); and
- discuss and recommend appropriate GNSS Strategy and Augmentation Systems for ACAC and MID States.

III. SESSIONS OF THE SEMINAR

3.1 The Workshop received nine (9) Presentations that were divided into four (4) Sessions. Sufficient time was allocated for discussions to identify the priority areas where pilot projects should be launched and examine possible partnerships that could be established.

Session 1: Regional Perspectives

ACAC Strategy Overview

3.1.1 The presentation by the chairman of the Working Group covered two areas ACAC objectives and strategy, where the ACAC objective was to develop GNSS training policy, programme and plan, support States to reach the Regional, and national PBN objective and ensure the coverage of the whole ACAC States. The ACAC GNSS strategy has phased approach for SBAS extension over ACAC Region in three terms: *Short Term* (EGNOS V2 in MEDA Region), *Medium Term* (to implement EGNOS V3 in MEDA Region and asses different SBAS extension to Middle East Region) *Long Term* (Independent Infrastructure).

Kingdom of Saudi Arabia Strategy of GNSS

3.1.2 Kingdom of Saudi Arabia Strategy of GNSS implementation is based on the establishment of GPMS in KSA to comply with ICAO requirements, Implement Core GNSS (without augmentation) for en-route and terminal operations, implement GBAS (GLS) in coordination with users and continue participation in ACAC activities for SBAS system for the Region.

ICAO Global Provisional and Regional Developments related to GNSS

3.1.3 The ICAO MID Regional Office presentation covered ICAO Global Provision on GNSS and the developments in the different ICAO Regions related to GNSS implementation; the Presentation addressed the different GNSS core constellation (GPS, GLONASS, Galileo, and Beidou), the augmentation system (ABAS,SBAS,GBAS), their standardization, GNSS infrastructure in place, aircraft provisions and their operational use by the aviation today. The evolution of the core constellation and the different augmentation systems were also covered the MID Air Navigation Strategy and the MID PBN implementation plan and targets were presented. It was concluded that early benefits through the ABAS supported (Basic GNSS) should be accomplished. The presentation highlighted that the selection of augmentation systems issues is not an easy solution. Any system implementation should be studied carefully and be based on operational requirements including fleet equipage and maturity of the systems.

3.1.4 Briefing on new guidance on GNSS monitoring for inclusion in the GNSS Manual and updates to Annex 10 that will become applicable by November 2018 was provided.

Session 2: Regional SBAS (EGNOS and GAGAN)

EGNOS Status and Plans

3.2.1 European Commission presented the current status of EGNOS adoption by aviation in EU (e.g. nearly 250 landing procedures across 176 airports) and of EGNOS extension activities to non-EU territories (Africa, Middle East, Ukraine). For next steps, they announced a Workshop dedicated to international agreements and reminded ACAC/MID Countries to send official letters to express interest in negotiating such agreement to use EGNOS.

EGNOS V2/V3 Developments

3.2.2 The European GNSS Space Agency's (GSA) presentation gave an overview of the EGNOS V2 system currently deployed and operated, as well as the foreseen evolutions. The presentation also provided ACAC with up-to-date information that could be used as inputs in the GNSS roadmap.

GAGAN Status and Plans

3.2.3 The GPS Aided Geo Augmented Navigation (GAGAN) system has been developed by Indian Space Research Organization (ISRO) and Airport Authority of India (AAI) to provide an operational SBAS system. The service area covers the Indian FIR. The GAGAN service provides Non precision approach, RNP-0.1, over Indian FIR and precision approach, APV-1.0 over land mass on nominal days. The system is interoperable with other SBAS system.

3.2.4 GAGAN system consists of Indian Reference stations (INRES), Indian Master Control Center (INMCC), Indian Land Uplink Station (INLUS), Space segment (two spacecraft) and data communication networks. GAGAN is certified for enroute operations (RNP 0.1) in December 2013 and for precision approach service (APV 1.0) in April 2015. Certified GAGAN signals are being broadcast since May 19, 2015.

3.2.5 The implementation plans for GAGAN in Indian are:

- Runways not equipped with ILS or at terrain constrained airports where ILS installation is not practicable, GAGAN approaches will provide the requisite vertical guidance.
- Small and new airports where only few aircraft movement exist.
- APV procedures for 6 Airports and in the process of development of additional nine airports. Testing & validation of these procedure is expected to be completed 2016. In the next 5 years, APV procedures for almost all operational airports in India.

3.2.6 The implementation plans for GAGAN neighbouring Regions:

- Service to all neighbouring Countries such as Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Myanmar, Sri Lanka etc. is possible.
- Countries of South East Asia, such as Thailand, Indonesia, Malaysia, Singapore and others over Australia and Africa falling within GEO foot print subject to installing Indian Reference Stations (INRES).

Session 3: Technological Developments

EGNOS in EUROMED States/MEDUSA

3.3.1 EGNOS (the European SBAS) and Galileo provide benefits to non-EU Countries, in terms of increased accuracy and reliability. Funded by the European Commission, the Euromed GNSS programme aims to extend and introduce EGNOS in the Countries of the Euromed Region, including North Africa and the Middle East Countries around the Mediterranean. The majority of the Euromed States are also members of ACAC: Algeria, Egypt, Jordan, Lebanon, Libya, Morocco, Palestine, Syria, and Tunisia. MEDUSA is the second phase of the Euromed GNSS programme aimed to assist the Countries of the Euromed Region in the introduction and exploitation of EGNOS services, in parallel with the on-going deployment of the ground infrastructure elements necessary for completing the EGNOS coverage extension across the Region. Running from 2012 and recently concluded at the

end of 2015, MEDUSA developed technical assistance, training, capacity building and Regional cooperation, in order to aid and prepare the Euromed Countries towards the use and optimal adoption of the EGNOS services in various domains.

3.3.2 Through MEDUSA outcomes, the Euromed Countries achieved important concrete progresses, they know the necessary steps to introduce EGNOS operations in aviation, and they are ready to start the necessary actions in this direction. Other non-EU Countries/Regions interested to use EGNOS can leverage on MEDUSA's experience.

EGNOS-AFRICA JPO: Support to EGNOS in Africa

3.3.3 EGNOS Africa JPO is key outcome of the Joint Africa-EU Strategy (JAES) regarding Africa-EU cooperation on satellite navigation. It has been operationalized through the ACP/EC framework Programme 'Support to the Air Transport and Satellite services applications in Africa' (SAFIR). JPO continuity is assured through the Pan'Af programme, adopted in November 2015, JPO's member Team expertise encompasses various multi- disciplinary domains from technical to legal and economics, certification, programme management.

3.3.4 JPO main activities included awareness of GNSS/EGNOS to Africa stakeholders, and the support for the definition of possible short term legal and institutional framework.

3.3.5 The proposition of a roadmap for EGNOS services implementation is based on JPO internal studies and outcomes of the working sessions. The proposed roadmap is a tool to assist States for harmonized introduction of cost-effective EGNOS/SBAS services, based on four modular implementation strategy and provides guidelines to address EGNOS deployment in Africa, in the medium-term (by 2028).

3.3.6 The targeted services and timeline in the proposed roadmap, EGNOS v2 L1 open service is expected by 2020, while Safety of Life NPA GPS is planned for 2021, and Safety of Life (NPA+APV1+LPV200 GPS) earliest availability is 2023. For V3 services, the respective services Open Service (GPS, GPS+GALILEO), Safety of Life (NPA GPS, GPS+GALILEO) and Safety of Life (NPA+APV1 + LPV200 GPS, GPS+GALILEO) are foreseen by 2025, 2026 and 2028.

3.3.7 In conclusion, the completion of the first phase of JPO mandate under SAFIR, has resulted in raising the capacity building strength in GNSS/EGNOS in Africa.

3.3.8 The development of a guideline document such as the proposed roadmap is a key achievement on which Africa could capitalize for the future GNSS/EGNOS implementation plans in Africa. JPO current work programme (under Pan'AF) provides opportunities for collaboration with all African organizations/States and initiatives in supporting their GNSS/EGNOS implementation plan in Africa. As such JPO looks forward to further cooperation with ACAC/ICAO MID with regards to GNSS/EGNOS implementation plan in Africa.

GBAS: Current Operations and Future Perspectives

3.3.9 Egis Avia, presentation covered the generic system architecture of Ground Based Augmentation System (GBAS), the augmentation developed within ICAO to deserve precision approach needs down to precision. The potential interest of GBAS has been illustrated through the point of views of an airline operator, of an airport operation and of an Air Navigation Service Provider to illustrate the wide range of benefits accessible for aviation stakeholders. The current status of commercial aircraft equipage with more than 1000 aircrafts already equipped with certified GBAS Landing System. On the ground segment side, an overview of current and future GBAS CAT I station over the globe has been presented. Aviation is also working on the provision of CAT II/III capability though GBAS with the GBAS, GASTD and GBAS GASTF concept. The presentation invited the audience to think about GBAS in ACAC highlighting the potential quick wins that may be achievable

through the implementation of GBAS. The first step of a potential implementation roadmap was detailed to support a decision making process on GBAS based on a technical feasibility study and cost benefits assessment considering local safety requirements, GNSS/GBAS fleet equipage, current navigation strategy plan for GNSS and conventional navigation aids and implementation cost. The presentation concluded that an evaluation of GBAS costs and benefits for implementation in ACAC Member States can be of interest as quick wins can be anticipated. Through the questions raised by the audience, the complementary of GBAS and SBAS became clear: there is not straightforward technical solution to be implemented, each individual case needs to be studied based on the operational requirement and concept of operation.

Session 4: Conclusion and Closing Session

3.4.1 In this session, the Workshop developed Recommendations that show how ACAC MID States can plan for optimum solution based on these criteria:

- Strategic
- Institutional frame work
- Time frame
- Knowledge and skills
- Resources

IV. RECOMMENDATIONS

4.1 The Workshop developed the following Recommendations:

- ACAC has to continue raise awareness regarding the Global Navigation Satellites System (GNSS: EGNOS, GBAS) (Workshops, Seminar and training etc.);

- ACAC GNSS WG AN Provide regular papers to the MIDANPIRG CNS SG;

- States to provide effective spectrum management and protection of Global Navigation Satellite System (GNSS) frequencies to reduce the likelihood of unintentional interference or degradation of GNSS performance;

- States engage all Stakeholders in all planning process;

- Plan the upgrade of Air Navigation systems based on the identification of needs and expectation of the air space users and the identification of the optimum solution from operational and economic perspective. Maximize the use of the available technologies before investing in any new technologies;

- States to share experience on GNSS and ASBU B0 Modules implementation including sharing of training and implementation packages and visits to other States;

- State to identify operational requirements/Scope and improvements and plan for implementation accordingly taking into account the cost benefits of the different Augmentation systems available;

- GAGAN (ISRO/AAI) to provide to CNS SG/7 details on the services and the requirement for extension of these services to the MID Region;

- EC to provide working papers to the CNS SG/7 on the progress achieved in the MID/ACAC States from the MEDUSA including the work programme for the Workshop in September which will discuss the template of the International Agreements;

- States participated in the MEDUSA interested in further progress on EGNOS activities have to send official letters to EC, and provide updates on their GNSS plans and implementations Status to the CNS SG/7;

- EC is ready to assist any ACAC States not participated in MEDUSA for the conduct of the cost benefit analysis free of charge upon official request from the CAA or ACAC;

- JPO and MID Region to share their experience on legal and institutional frame work on EGNOS implementation. JPO is also ready will provide support to interested African States;

- ACAC and ICAO assist in harmonization to enhance interoperability and maximize available resources;

- ACAC GNSS WG with ICAO Support to carry out the study to assess the likelihood and effects of Global Navigation Satellite System Vulnerabilities in the MID Region airspace;

- CNS SG and GNSS WG to develop MID Region GNSS mitigation strategy;

- Regional and Global coordination should be improved in order to define and meet the requirements of the Regional ANP and GANP; and

- Evaluation of the implementation of GBAS system costs and benefits in the area of Arab Countries.

V. CLOSING

5.1 In closing, Mr. Mohamed Rejeb, Air Navigation and Safety ACAC Expert and Mr. Raza Gulam, RO/CNS, ICAO Middle East Regional Office thanked the participants for their presence and expressed ACAC/ICAO MID gratitude to EC, GSA, EGIS AVIA, JPO, TELSPAZIO and Chairperson ACAC/GNSS WG for their valuable information and the excellent support to the Workshop.

5.2 The participants recognized the usefulness of the event and expressed their thanks to ACAC/ICAO MID for organizing such a fruitful Workshop and underlined the importance of necessary follow-up actions on the Recommendations mentioned above, and the conduct of additional Joint ACAC/ICAO MID Seminars and Workshops.

Attachment A

الهيئة العربية للطيران المدني

ورشة عمل الملاحة بالأقمار الصناعية

الرباط، 5 أبريل 2016

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الهيئة العربية للطيران المدني

ورشة عمل الملاحة بالأقمار الصناعية

الرباط، 5 أبريل 2016

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Attachment B

Joint ACAC/ICAO MID WORKSHOP ON GNSS

Golden Tulip Farah- Rabat, Morocco

(5 April 2016)

Work Programme

09:00 – 09:30	Opening	Mr. Mohamed Ibrahim Sherif, CEO, ACAC Mr. Raza Gulam, RO/CNS, ICAOMID
Session 1: Global Provisions and Regional perspectives		
09:30 – 09:45	ACAC Strategy Overview	Mr. Khalid AL MATRAFI -ACAC Chairman GNSS WG
09:45 – 10:15	ICAO Global Provisions and Regional Developments related to GNSS	Mr. Raza Gulam – RO/CNS, ICAOMID Regional Office
10:15 – 10:30	Panel Discussion	ALL
10:30 – 11:00	Group Photo and Break	ALL
Session 2: Regional SBAS: EGNOS and GAGAN		
11:00 – 11:30	EGNOS Status and Plans	Mr. Ugo CELESTINO -EC
11:30 – 12:00	EGNOS V2/V3 Developments	Mrs Anne Laure Vogel - GSA
12:00– 12:30	GAGAN Status and Plans	Mr. RAMASUBRAMANIAN- ISRO
12:30 – 12:45	Panel Discussion	ALL
12:45- 13:00	Coffee Break	ALL
Session 3: Technological Developments		
13:00 – 13:30	EGNOS in EUROMED States/MEDUSA	Ms. Antonella DI FAZIO – Telespazio
13:30 – 14:00	EGNOS-AFRICA JPO: Support to EGNOS in Africa	Mr. Sémou DIOUF- EGNOS AFRICA JPO
14:00 – 14:30	GBAS: Current Operations and Future Perspectives	Mr. Mikael MABILLEAU- Egis Avia
14:30 – 15:00	Panel Discussion	ALL
Session 4: Conclusions and Closing Session		
15:00 – 15:30	Conclusions, Recommendation & Open Discussion	Mr. Khalid AL MATRAFI -ACAC Chairman GNSS WG
15:30 – 16:00	Closing Session	All

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