



International Civil Aviation Organization

**Performance Based Navigation/Global Navigation Satellite System
Task Force (PBN/GNSS TF)**

Fifth Meeting
(Cairo, Egypt, 15 - 17 April 2013)

Agenda Item 3: Developments in PBN and GNSS

GLOBAL DEVELOPMENTS AND OTHER ICAO REGIONS PBN TF

(Presented by the Secretariat)

<p style="text-align: center;">SUMMARY</p> <p>This paper presents the outcome of PBN Symposium and Workshops and some activities of other ICAO Region related to PBN and GNSS</p> <p>Action by the meeting is at paragraph 3.</p>
<p style="text-align: center;">REFERENCES</p> <ul style="list-style-type: none">- Other ICAO regions PBN Reports- PBN Symposium results- Twelfth Air Navigation Conference report

1. INTRODUCTION

1.1 The MIDANPIRG/13 Meeting was held in Abu Dhabi, UAE, from 22 to 26 April 2012. The meeting adopted 71 Conclusions and Decisions of which seventeen (17) Conclusions are considered relevant to the work of the PBN/GNSS TF.

1.2 The PBN GNSS TF/4 Meeting held in Cairo, Egypt, 02 - 04 October 2011, was attended by 26 participants, which included experts from eight (8) States (Bahrain, Egypt, Jordan, Kuwait, Oman, Qatar, Saudi Arabia and U.A.E.) and one (1) International Organizations (IATA). The meeting developed six (6) Conclusions and two (2) Decisions.

1.3 PBN Symposium and Workshops were held in Montréal from 15 to 19 October 2012. The Twelfth Air Navigation Conference (AN-Conf/12) held in Montreal from 19 to 30 November 2012, gained consensus, commitments and formulated recommendations to achieve a harmonized Global Air Navigation System for International Civil Aviation, in order to optimize the opportunities in technology and maturing work programmes toward common global objectives. The AN-Conf/12 considered Aviation System Block Upgrades (ASBUs) and the Communications, Navigation, Surveillance (CNS), Aeronautical Information Management (AIM) and avionics roadmaps for inclusion in the Global Air Navigation Plan.

2. DISCUSSION

2.1 The meeting may wish to recall that frequency interference-free operation of Global Navigation Satellite System (GNSS) is essential. The meeting may wish to further recall that the frequency band 1 559 - 1 610 MHz, is used for elements of GNSS.

2.2 The MIDANPIRG/13 Meeting noted that the International Telecommunication Union (ITU) process, allows under footnotes No. 5.362B and 5.362C the operation of fixed service in some States on a secondary basis until 1 January 2015. The continued use by the fixed service constitutes a severe constraint on the safe and effective use of GNSS in some areas of the world, as distances of up to 400 km between the stations of the fixed service and the aircraft is required to ensure safe operation of GNSS. Ten States have removed their names from footnotes 5.362B and 5.362C during WRC-12. This was a significant step forward towards achieving better worldwide protection of GNSS.

2.3 The meeting may wish to note that the MIDANPIRG/13 Meeting urged the following MID States (*Iraq, Jordan, Qatar, Sudan, Syria and Yemen*) to delete their names from the footnotes 5.362B and/or 5.362C and agreed to the following Conclusion:

CONCLUSION 13/44: PROTECTION OF GNSS SIGNAL

That, States that are listed in the footnotes 5.362B and 5.362C be urged to take necessary measures to remove their names from these footnotes as soon as possible.

2.4 Based on the above the ICAO MID Regional Office sent a follow-up State letter AN 6/28-12/217 dated 18 July 2012, requesting Civil Aviation Authorities to coordinate with the Telecommunication Regulatory Authority in their State, to remove their State name from the footnotes No. 5.362B and 5.362C. However, reviewing ICAO HQ SL E 3/5-12/62 dated 28 November 2012 and the attached WRC position the same States Names appear

2.5 Accordingly, the meeting may wish to recommend further actions to support the deletion State names from footnotes of Nos. **5.362B** and **5.362C** as of 2015 in order to eliminate harmful interference that has been caused by the fixed service to essential aeronautical radio navigation satellite functions in the band 1 559 – 1 610 MHz and to permit the full utilization of GNSS services to aircraft on a global basis.

2.6 The meeting may wish to note that MIDANPIRG/13 reviewed and updated the Strategy for the implementation of GNSS in the MID Region to be in line with ICAO General Assembly Resolution A37-11. Accordingly, the MIDANPIRG/13 Meeting agreed to the following Conclusion:

CONCLUSION 13/45: STRATEGY FOR THE IMPLEMENTATION OF GNSS IN THE MID REGION

*That, the Strategy for implementation of GNSS in the MID Region be updated as at **Appendix 4.5R (Appendix A to this working paper)** to the Report on Agenda Item 4.*

2.7 MIDANPIRG/13 Meeting encouraged MID States to conduct GNSS studies, workshops and seminars, since GNSS is the only sensor that supports all PBN navigation specifications. Accordingly, MIDANPIRG/13 Meeting agreed to conduct a survey on the implementation of GNSS in the MID Region, and agreed to the following Conclusion:

CONCLUSION 13/46: GNSS SURVEY

*That, States complete the GNSS questionnaire at **Appendix 4.5S** to the Report on Agenda Item 4.5 and send it to the ICAO MID Regional Office before 1 September 2012.*

2.8 As follow-up to above ICAO MID Regional Office Issued State Letter AN 6/28-12/216 dated 18 July 2012 and the following States replied (Jordan, Kuwait, Oman, and Qatar), as at **Appendix B** to this working paper.

2.9 The 12th Air Navigation Conference noted the information on the implementation status of Global Navigation Satellite System (GNSS) constellations and augmentations systems, and considered a number of related implementation issues. Mainly the modernization of Global Positioning System (GPS), and Global Navigation Satellite System (GLONASS). Furthermore the AN-Conf/12 noted the updates Galileo GNSS constellation, the BeiDou system, a GNSS constellation developed and operated by China, implementation status of several Satellite-Based Augmentation Systems (EGNOS, GAGAN) and discussed the introduction of multi-constellation, multi-frequency GNSS will entail number of new technical and regulatory challenges beyond those already associated with current GNSS implementation.

2.10 The AN-Conf/12 agreed to the following Recommendations concerning GNSS:

Recommendation 6/5 – ICAO Work Programme to support Global Navigation Satellite System Evolution

That, ICAO undertake a work programme to address:

- a) interoperability of existing and future Global Navigation Satellite System constellations and augmentation systems, with particular regard to the technical and operational issues associated with the use of multiple constellations;
- b) identification of operational benefits to enable air navigation service providers and aircraft operators to quantify these benefits for their specific operational environment; and
- c) continued development of Standards and Recommended Practices and guidance material for existing and future Global Navigation Satellite System elements and encouraging the development of industry standards for avionics.

Recommendation 6/6 – Use of Multiple Constellations

That, States when defining their air navigation strategic plans and introducing new operations:

- a) take advantage of the improved robustness and availability made possible by the existence of multiple Global Navigation Satellite System constellations and associated augmentation systems;
- b) publish information specifying the Global Navigation Satellite System elements that are approved for use in their airspace;
- c) adopt a performance-based approach with regard to the use of Global Navigation Satellite System (GNSS), and avoid prohibiting the use of GNSS elements that are compliant with applicable ICAO Standards and Recommended Practices;

- d) carefully consider and assess if mandates for equipage or use of any particular Global Navigation Satellite System core constellation or augmentation system are necessary or appropriate; and

That, aircraft operators:

- e) consider equipage with GNSS receivers able to process more than one constellation in order to gain the benefits associated with the support of more demanding operations.

2.11 The meeting may wish to note that AN-Conf/12 also discussed Mitigating GNSS vulnerabilities where it was noted that the very low strength of GNSS signals received from satellites makes GNSS vulnerable to interference and other effects that have the potential to affect multiple aircraft over a wide area. The sources of GNSS vulnerabilities include unintentional interference, intentional interference, effects of the ionosphere and solar activity (space weather) and others.

2.12 The AN-Conf/12 Meeting noted that Intentional Interference to GNSS fell into the category of the cyber security issues addressed by Recommendation 2/3 of the Conference and Annex 17-Security-Safeguarding International Civil Aviation against Acts of Unlawful Interference, Chapter 4, 4.9.

2.13 The meeting then considered a number of measures that can be taken to reduce the likelihood of GNSS signal disruption due to the sources described above. For example, the introduction of new constellations and frequencies for GNSS will significantly reduce the probability of loss of service caused by unintentional interference, by virtue of the diversity of frequencies and increased number of satellites in view. The availability of dual GNSS frequencies will also help compensate for the ionosphere delay effect.

2.14 The meeting recognized that the primary means to reduce the likelihood of both intentional and unintentional interference is effective spectrum management. This involves the creation of a strong regulatory framework controlling the allocation and use of spectrum in such a way as to secure protection of GNSS frequencies. At the national level, this is the responsibility of the Radio Regulatory Authorities in each State. At the international level, the International Telecommunication Union (ITU) provides such a framework through its Radio Regulations.

2.15 The meeting acknowledged that, even though the likelihood of GNSS signal disruption can be significantly reduced as discussed above, disruption cannot be completely ruled out, and therefore ANSPs must be prepared to deal with potential loss of GNSS signals. This requires the completion of a risk assessment that will determine the residual likelihood of service outages and the impact of an outage in specific airspace, and the application of realistic and effective mitigation strategies to ensure the safety and regularity of air services and to discourage those seeking to disrupt operations.

2.16 The meeting was also informed that several States have identified the need for an Alternative Position, Navigation and Timing (APNT) strategy, with the goal of maintaining air navigation services to the maximum extent possible in the event of a GNSS signal outage, by taking advantage of current systems, and defining a realistic evolution path.

2.17 The AN-Conf/12 adopted the following Recommendations:

Recommendation 6/7 – Assistance to States in Mitigating Global Navigation Satellite System Vulnerabilities

That, ICAO:

- a) continue technical evaluation of known threats to the Global Navigation Satellite System, including space weather issues, and make the information available to States;
- b) compile and publish more detailed guidance for States to use in the assessment of Global Navigation Satellite System vulnerabilities;
- c) develop a formal mechanism with the International Telecommunication Union and other appropriate UN bodies to address specific cases of harmful interference to the Global Navigation Satellite System reported by States to ICAO; and
- d) assess the need for, and feasibility of, an alternative position, navigation and timing system.

Recommendation 6/8 – Planning for Mitigation of Global Navigation Satellite System Vulnerabilities

That, States:

- a) assess the likelihood and effects of Global Navigation Satellite System vulnerabilities in their airspace and apply, as necessary, recognized and available mitigation methods;
- b) 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;
- c) report to ICAO cases of harmful interference to Global Navigation Satellite System that may have an impact on International Civil Aviation operations;
- d) develop and enforce a strong regulatory framework governing the use of Global Navigation Satellite System repeaters, pseudolites, spoofers and jammers;
- e) allow for realization of the full advantages of on-board mitigation techniques, particularly inertial navigation systems; and
- f) where it is determined that terrestrial aids are needed as part of a mitigation strategy, give priority to retention of Distance Measuring Equipment (DME) in support of Inertial Navigation System (INS)/DME or DME/DME area navigation, and of Instrument Landing System at selected runways.

Recommendation 6/9 – Ionosphere and Space Weather Information for Future Global Navigation Satellite System Implementation

That, ICAO:

- a) coordinate regional and global activities on ionosphere characterization for Global Navigation Satellite System implementation;
- b) continue its effort to address the Global Navigation Satellite System (GNSS) vulnerability to space weather to assist States in GNSS implementation taking into account of long-term GNSS evolution as well as projected space weather phenomena;
- c) study the optimum use of space weather information that is globally applicable from low to high magnetic latitude regions for enhanced Global Navigation Satellite System performance at a global context; and

That, States:

- d) consider a collaborative approach to resolve ionospheric issues including ionospheric characterization for cost-effective, harmonized and regionally suitable Global Navigation Satellite System implementation.

2.18 Furthermore, the AN-Conf/12 discussed the opportunities for the rationalization of terrestrial navigation aids arising with the implementation of Performance-Based Navigation enabled by GNSS capability in the aircraft. It considered an approach that aimed at maximizing the greatest economic benefits of rationalization, namely those that come from avoiding the replacement of navigation aids at the end of their lifecycle. The approach was based on an analysis aimed at identifying rationalization opportunities, evaluating the necessary route changes and determining whether a limited PBN implementation on the affected routes would be more cost effective than the replacement of the aids.

2.19 The committee noted that one constraint on the rationalization process is that a minimum network of terrestrial aids should be maintained to cope with temporary loss of GNSS service. In general, the fundamental requirement to be met by such a network is to fully maintain safety following the loss of GNSS service, and maintain an acceptable level of efficiency and continuity to the extent possible, and agreed to following recommendation

Recommendation 6/10 – Rationalization of Terrestrial Navigation Aids

That, in planning for the implementation of Performance-Based Navigation, States should:

- a) assess the opportunity for realizing economic benefits by reducing the number of navigation aids through the implementation of Performance-Based Navigation;
- b) ensure that an adequate terrestrial navigation and air traffic management infrastructure remains available to mitigate the potential loss of Global Navigation Satellite System service in their airspace; and
- c) align Performance-Based Navigation implementation plans with navigation aid replacement cycles, where feasible, to maximize cost savings by avoiding unnecessary infrastructure investment.

3. ACTION BY THE MEETING**3.1** The meeting is invited to:

- a) urge concerned State to remove their name from footnotes affecting GNSS signal;
- b) update MID GNSS Implementation Strategy as necessary;
- c) urge States to increase use of GNSS-based instrument procedure;
- d) support CNS SG with the rationalization plan for NAVAIDs; and
- e) conduct shared studies on GNSS.

APPENDIX A

MIDANPIRG/13-REPORT
APPENDIX 4.5R

MIDANPIRG/13
Appendix 4.5R to the Report on Agenda Item 4.5

REVISED STRATEGY FOR THE IMPLEMENTATION OF GNSS IN THE MID REGION

The following is the Strategy for the implementation of GNSS aligned with PBN in the MID Region:

Considering that:

- a) Safety is the highest priority.
- b) Elements of Global Air Navigation Plan on GNSS and requirements for the GNSS implementation will be incorporated into the CNS part of FASID.
- c) GNSS Standards and Recommended Practices (SARPs), PANS and guidance material for GNSS implementation are available.
- d) Human, environmental and economic factors will affect the implementation.
- e) The availability of avionics, their capabilities and the level of user equipage.
- f) The development of GNSS systems including satellite constellations, augmentation systems and improvement in system performance.
- g) The airworthiness and operational approvals allowing the current GNSS applied for en-route and non-precision approach phases of flight without the need for augmentation services external to the aircraft.
- h) The effects of ionosphere on GNSS and availability of mitigation techniques;
- i) The PBN concept and the availability of PBN guidance material
- j) The monitoring of the GNSS signal according to ICAO Document 9849 (GNSS Manual) and other related ICAO documents
- k) States pay fair cost for GNSS to service providers (according to ICAO provisional policy guidance on GNSS cost allocation)

The general strategy for the implementation of GNSS in the MID Region is detailed below:

- 1) Introduction of GNSS Navigation Capability should be consistent with the Global Air Navigation Plan.
- 2) Implementation of GNSS and Augmentations should be in full compliance with ICAO Standards and Recommended Practices and PANS.
- 3) Assessment of the extent to which the GNSS system accessible in the Region can meet the navigational requirements of ATM service providers and aircraft operators in the Region.
- 4) Introduce the use of GNSS with appropriate augmentation systems, as required, for en-route navigation and Implementation of approach procedures with vertical guidance (Baro-VNAV and/or augmented GNSS), including LNAV only minima, for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30 per cent by 2010, 70 per cent by 2014 as per 37th

ICAO General Assembly resolutions 37-11 and according to Regional PBN Implementation Plan.

- 5) States, in their planning and introduction of GNSS services, take full advantage of future benefits accrued from using independent core satellite constellations, other GNSS elements and their combinations, and avoid limitations on the use of specific system elements.
- 6) Facilitate the use of GNSS; as enabler for PBN for en-route, terminal, approach and departure navigation. States should coordinate to ensure that harmonized separation standards and procedures are developed and introduced concurrently in adjacent flight information regions along major traffic flows to allow for a seamless transition to GNSS based navigation.
- 7) States should to the extent possible work co-operatively on a multinational basis under ICAO MID Office guidance to implement GNSS in order to facilitate seamless and inter-operable systems and undertake coordinated R&D programmes on GNSS implementation and operation.
- 8) States consider segregating traffic according to navigation capability and granting preferred routes to aircraft that are appropriately equipped for PBN to realize the benefits of such equipage taking due consideration of the need of State aircraft.
- 9) ICAO and States should undertake education and training programs to provide necessary knowledge in AIM, PBN, GNSS, Augmentation systems and operational application.
- 10) States establish multidisciplinary GNSS implementation teams, using section 5.2.2 and Appendix C of ICAO Document 9849, GNSS Manual.
- 11) States, in their planning for implementation of GNSS services, provide effective spectrum management and protection of GNSS frequencies to reduce the possibility of unintentional interference.
- 12) During transition to GNSS, sufficient ground infrastructure for current navigation systems must remain available. Before existing ground infrastructure is considered for removal, users should be given reasonable transition time to allow them to equip accordingly.
- 13) States should approach removal of existing ground infrastructure with caution to ensure that safety is not compromised, such as by performance of safety assessment, consultation with users through regional air navigation planning and plan for complete decommissioning of NDBs by 2012.
- 14) Implement GNSS with augmentation as required for APV where operationally required in accordance with the MID Regional and National PBN Implementation plans.
- 15) States continue their efforts to implement GNSS applications for en-route, APV and TMA operations. Attention should be accorded to meeting all GNSS implementation requirements, including establishment of GNSS legislation, regulatory framework, and approval procedure.

Notes:

GNSS (and ABAS using RAIM in particular) is available on a worldwide basis, not much needs to be done in terms of infrastructure assessment. Nonetheless, the responsibility for providing services based on GNSS within the airspace of a particular State remains within that State.

A decision on whether or not to develop a status monitoring and NOTAM system for ABAS operations should be made by taking into account the nature of PBN approvals. In many cases ABAS operations are predicated on having a full complement of traditional NAVAIDs available for back-up when ABAS cannot support service.

APPENDIX B

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State Name: State of Kuwait

Contact Name:

Contact email:

- 1) Has your State developed a plan to implement GNSS?
Yes
- 2) Was the GNSS Manual (Doc 9849) used as a reference when considering the implementation of GNSS?
Yes
- 3) Has the basic GNSS regulation been promulgated in your State?
Yes
- 4) a-Has your administration received requests from domestic aircraft operators to provide GNSS-based services ?
Yes

b-Has your administration received requests from international aircraft operators to provide GNSS-based services?
Yes
- 5) What is the level of WGS – 84 survey completion in your State
 - a. For Waypoints : 90%
 - b. For Airports : 100%
- 6) What percentage of aircraft are equipped with GNSS avionics
100 % JAZERAH AIRWAYS
40% KUWAIT AIRWAYS
- 7) a- What is the number of runways in your State that meet instrument standards but do not have an instrument approach?
ALL RUNWAYS have Instrument Approach Landing procedures.

b- What is the number of runways in your State that are only served by a circling procedure
NON
- 8) In your State, how many PBN approach procedures are promulgated based on
 - a. GNSS: 4 ILS /RNAV(GNSS) & 4 RNAV (GNSS) approach procedures .
 - b. Conventional navigation-aids:
 - 2 DVOR/DME
 - 4 ILS GP/DME
 - 4 LLZ
 - 4 Middle Marker(MM)

- 9) How many ILS systems are equipped with marker beacons only (no DME) for aircraft to perform altitude/distance cross checks?

4 Middle Marker (MM)

- 10) Do you allow the use of FMS GPS based computed distance checks?

-- ☐ Yes ☐ No

- 11) Does your State plan to implement ADS-B ?

Yes When: 2013

- 12) Does your State plan to implement Multilateration -- ☐ Yes When _____ ☐ No

- 13) What is the Status of the following systems in your State

a. ADS-C -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

b. CPDLC -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

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- 14) Does your State have any plans to implement augmentation systems

a. SBAS : No

b. GBAS : Yes When : 2016

- 15) What role would your State like ICAO to assume in your GNSS Programme

For all our future GNSS Program, we like to have full co-operation from ICAO.

- 16) Any comments

NIL

- END -

APPENDIX B

GNSS ASSESSMENT SURVEY

The following GNSS survey has been developed by ICAO to assess the Regional (Global) level of GNSS implementation and to determine the role that States would like ICAO to assume

Please return the completed survey to icaomid@cairo.icao.int by 30 June 2012

State Name: OMAN

Contact Name:

Contact email:

- 1) Has your State developed a plan to implement GNSS -- ☒ Yes ☐ No
- 2) Was the GNSS Manual (Doc 9849) used as a reference when considering the implementation of GNSS ☒ Yes ☐ No
- 3) Has the basic GNSS regulation been promulgated in your State -- ☒ Yes ☐ No
- 4) a- Has your administration received requests from domestic aircraft operators to provide GNSS-based services -- ☒ Yes ☐ No

b- Has your administration received requests from international aircraft operators to provide GNSS-based services -- ☒ Yes ☐ No
- 5) What is the level of WGS - 84 survey completion in your State
 - a. For Waypoints -- 100%
 - b. For Airports -- 100%
- 6) What percentage of aircraft are equipped with GNSS avionics 100%
- 7) a- What is the number of runways in your State that meet instrument standards but do not have an instrument approach 3

b- What is the number of runways in your State that are only served by a circling procedure
NONE
- 8) In your State, how many PBN approach procedures are promulgated based on
 - a. GNSS -- 6
 - b. Conventional navigation-aids NONE
- 9) How many ILS systems are equipped with marker beacons only (no DME) for aircraft to perform altitude/distance cross checks? NONE

10) Do you allow the use of FMS GPS based computed distance checks? --☒ Yes ☐ No

11) Does your State plan to implement ADS-B --☒ Yes When 2015 ☐ No

12) Does your State plan to implement Multilateration --☒ Yes When 2015 ☐ No

13) What is the Status of the following systems in your State

- a. ADS-C -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No
b. CPDLC -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

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14) Does your State have any plans to implement augmentation systems

- a. SBAS -- ☐ Yes When ☒ No
b. GBAS -- ☒ Yes When 2016 ☐ No

15) What role would your State like ICAO to assume in your GNSS Programme

ADVISORY

16) Any comments

-END-

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ATTACHMENT A
STATE LETTER REF: AN 6/28-12/216

GNSS ASSESSMENT SURVEY

The following GNSS survey has been developed by ICAO to assess the Regional (Global) level of GNSS implementation and to determine the role that States would like ICAO to assume

Please return the completed survey to icaomid@cairo.icao.int before 1 September 2012

State Name: Jordan

Contact Name: Eng. Amer Al-Jahmi

Contact email: a_jahmi@yahoo.com; Amer.jahmi@carc.gov.jo

- 1) Has your State developed a plan to implement GNSS -- ☒ Yes ☐ No
- 2) Was the GNSS Manual (Doc 9849) used as a reference when considering the implementation of GNSS ☒ Yes ☐ No
- 3) Has the basic GNSS regulation been promulgated in your State -- ☐ Yes ☒ No
- 4) a-Has your administration received requests from domestic aircraft operators to provide GNSS-based services -- ☐ Yes ☒ No
b-Has your administration received requests from international aircraft operators to provide GNSS-based services -- ☐ Yes ☒ No
- 5) What is the level of WGS - 84 survey completion in your State
 - a. For Waypoints -- 100 %
 - b. For Airports -- 100 %
- 6) What percentage of aircraft are equipped with GNSS avionics -- Statistics process under development
- 7) a- What is the number of runways in your State that meet instrument standards but do not have an instrument approach 1
b- What is the number of runways in your State that are only served by a circling procedure - 1
- 8) In your State, how many PBN approach procedures are promulgated based on
 - a. GNSS -- 0
 - b. Conventional navigation-aids -- 0
- 9) How many ILS systems are equipped with marker beacons only (no DME) for aircraft to perform altitude/distance cross checks? -- 0 (Markers will be replaced by DME within 6 months)

10) Do you allow the use of FMS GPS based computed distance checks? -- ☒ Yes ☐ No

11) Does your State plan to implement ADS-B -- ☒ Yes When - 2012 ☐ No

12) Does your State plan to implement Multilateration -- ☒ Yes When - within 5 years ☐ No

13) What is the Status of the following systems in your State

a. ADS-C -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

b. CPDLC -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

14) Does your State have any plans to implement augmentation systems

a. SBAS -- ☐ Yes When _____ ☒ No

b. GBAS -- ☒ Yes When 2015 ☐ No

15) What role would your State like ICAO to assume in your GNSS Programme

A) To expand EGNOS service to cover Jordan.

B) To standardize training of GNSS

C) To provide states with best practice GNSS Implementation worldwide.

16) Any comments

- END -

GNSS ASSESSMENT SURVEY

The following GNSS survey has been developed by ICAO to assess the Regional (Global) level of GNSS implementation and to determine the role that States would like ICAO to assume

Please return the completed survey to icaomid@cairo.icao.int before 1 September 2012

State Name: State of Qatar

Contact Name: Faisal Alqahtani

Contact email: Faisal.Alqahtani@caa.gov.qa

- 1) Has your State developed a plan to implement GNSS -- ☒ Yes ☐ No
- 2) Was the GNSS Manual (Doc 9849) used as a reference when considering the implementation of GNSS ☒ Yes ☐ No
- 3) Has the basic GNSS regulation been promulgated in your State -- ☐ Yes ☒ No - ICAO Document used as reference
- 4) a-Has your administration received requests from domestic aircraft operators to provide GNSS-based services -- ☒ Yes ☐ No

b-Has your administration received requests from international aircraft operators to provide GNSS-based services -- ☒ Yes ☐ No
- 5) What is the level of WGS - 84 survey completion in your State
 - a. For Waypoints -- 100%
 - b. For Airports -- 100%
- 6) What percentage of aircraft are equipped with GNSS avionics +85%
- 7) a- What is the number of runways in your State that meet instrument standards but do not have an instrument approach Nil

b- What is the number of runways in your State that are only served by a circling procedure Nil
- 8) In your State, how many PBN approach procedures are promulgated based on
 - a. GNSS - 4
 - b. Conventional navigation-aids - 15
- 9) How many ILS systems are equipped with marker beacons only (no DME) for aircraft to perform altitude/distance cross checks? Nil

10) Do you allow the use of FMS GPS based computed distance checks? -- ☐ Yes ☒ No -- For
Landing Procedures

11) Does your State plan to implement ADS-B -- ☒ Yes When 2010 ☐ No

12) Does your State plan to implement Multilateration -- ☒ Yes When _____ ☐ No

13) What is the Status of the following systems in your State

a. ADS-C -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

b. CPDLC -- Equipped ☒ Yes ☐ No Operational ☒ Yes ☐ No

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14) Does your State have any plans to implement augmentation systems

a. SBAS -- ☒ Yes When 2022 ☐ No

b. GBAS -- ☒ Yes When 2022 ☐ No

15) What role would your State like ICAO to assume in your GNSS Programme
Oversight only

16) Any comments

No.

- END -

APPENDIX A

MIDANPIRG/13-REPORT
APPENDIX 4.5R

MIDANPIRG/13
Appendix 4.5R to the Report on Agenda Item 4.5

REVISED STRATEGY FOR THE IMPLEMENTATION OF GNSS IN THE MID REGION

The following is the Strategy for the implementation of GNSS aligned with PBN in the MID Region:

Considering that:

- a) Safety is the highest priority.
- b) Elements of Global Air Navigation Plan on GNSS and requirements for the GNSS implementation will be incorporated into the CNS part of FASID.
- c) GNSS Standards and Recommended Practices (SARPs), PANS and guidance material for GNSS implementation are available.
- d) Human, environmental and economic factors will affect the implementation.
- e) The availability of avionics, their capabilities and the level of user equipage.
- f) The development of GNSS systems including satellite constellations, augmentation systems and improvement in system performance.
- g) The airworthiness and operational approvals allowing the current GNSS applied for en-route and non-precision approach phases of flight without the need for augmentation services external to the aircraft.
- h) The effects of ionosphere on GNSS and availability of mitigation techniques;
- i) The PBN concept and the availability of PBN guidance material
- j) The monitoring of the GNSS signal according to ICAO Document 9849 (GNSS Manual) and other related ICAO documents
- k) States pay fair cost for GNSS to service providers (according to ICAO provisional policy guidance on GNSS cost allocation)

The general strategy for the implementation of GNSS in the MID Region is detailed below:

- 1) Introduction of GNSS Navigation Capability should be consistent with the Global Air Navigation Plan.
- 2) Implementation of GNSS and Augmentations should be in full compliance with ICAO Standards and Recommended Practices and PANS.
- 3) Assessment of the extent to which the GNSS system accessible in the Region can meet the navigational requirements of ATM service providers and aircraft operators in the Region.
- 4) Introduce the use of GNSS with appropriate augmentation systems, as required, for en-route navigation and Implementation of approach procedures with vertical guidance (Baro-VNAV and/or augmented GNSS), including LNAV only minima, for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30 per cent by 2010, 70 per cent by 2014 as per 37th

ICAO General Assembly resolutions 37-11 and according to Regional PBN Implementation Plan.

- 5) States, in their planning and introduction of GNSS services, take full advantage of future benefits accrued from using independent core satellite constellations, other GNSS elements and their combinations, and avoid limitations on the use of specific system elements.
- 6) Facilitate the use of GNSS; as enabler for PBN for en-route, terminal, approach and departure navigation. States should coordinate to ensure that harmonized separation standards and procedures are developed and introduced concurrently in adjacent flight information regions along major traffic flows to allow for a seamless transition to GNSS based navigation.
- 7) States should to the extent possible work co-operatively on a multinational basis under ICAO MID Office guidance to implement GNSS in order to facilitate seamless and inter-operable systems and undertake coordinated R&D programmes on GNSS implementation and operation.
- 8) States consider segregating traffic according to navigation capability and granting preferred routes to aircraft that are appropriately equipped for PBN to realize the benefits of such equipage taking due consideration of the need of State aircraft.
- 9) ICAO and States should undertake education and training programs to provide necessary knowledge in AIM, PBN, GNSS, Augmentation systems and operational application.
- 10) States establish multidisciplinary GNSS implementation teams, using section 5.2.2 and Appendix C of ICAO Document 9849, GNSS Manual.
- 11) States, in their planning for implementation of GNSS services, provide effective spectrum management and protection of GNSS frequencies to reduce the possibility of unintentional interference.
- 12) During transition to GNSS, sufficient ground infrastructure for current navigation systems must remain available. Before existing ground infrastructure is considered for removal, users should be given reasonable transition time to allow them to equip accordingly.
- 13) States should approach removal of existing ground infrastructure with caution to ensure that safety is not compromised, such as by performance of safety assessment, consultation with users through regional air navigation planning and plan for complete decommissioning of NDBs by 2012.
- 14) Implement GNSS with augmentation as required for APV where operationally required in accordance with the MID Regional and National PBN Implementation plans.
- 15) States continue their efforts to implement GNSS applications for en-route, APV and TMA operations. Attention should be accorded to meeting all GNSS implementation requirements, including establishment of GNSS legislation, regulatory framework, and approval procedure.

Notes:

GNSS (and ABAS using RAIM in particular) is available on a worldwide basis, not much needs to be done in terms of infrastructure assessment. Nonetheless, the responsibility for providing services based on GNSS within the airspace of a particular State remains within that State.

A decision on whether or not to develop a status monitoring and NOTAM system for ABAS operations should be made by taking into account the nature of PBN approvals. In many cases ABAS operations are predicated on having a full complement of traditional NAVAIDs available for back-up when ABAS cannot support service.

APPENDIX B

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State Name: State of Kuwait

Contact Name:

Contact email:

- 1) Has your State developed a plan to implement GNSS?
Yes
- 2) Was the GNSS Manual (Doc 9849) used as a reference when considering the implementation of GNSS?
Yes
- 3) Has the basic GNSS regulation been promulgated in your State?
Yes
- 4) a-Has your administration received requests from domestic aircraft operators to provide GNSS-based services ?
Yes

b-Has your administration received requests from international aircraft operators to provide GNSS-based services?
Yes
- 5) What is the level of WGS – 84 survey completion in your State
 - a. For Waypoints : 90%
 - b. For Airports : 100%
- 6) What percentage of aircraft are equipped with GNSS avionics
100 % JAZERAH AIRWAYS
40% KUWAIT AIRWAYS
- 7) a- What is the number of runways in your State that meet instrument standards but do not have an instrument approach?
ALL RUNWAYS have Instrument Approach Landing procedures.

b- What is the number of runways in your State that are only served by a circling procedure
NON
- 8) In your State, how many PBN approach procedures are promulgated based on
 - a. GNSS: 4 ILS /RNAV(GNSS) & 4 RNAV (GNSS) approach procedures .
 - b. Conventional navigation-aids:
 - 2 DVOR/DME
 - 4 ILS GP/DME
 - 4 LLZ
 - 4 Middle Marker(MM)

- 9) How many ILS systems are equipped with marker beacons only (no DME) for aircraft to perform altitude/distance cross checks?

4 Middle Marker (MM)

- 10) Do you allow the use of FMS GPS based computed distance checks?

-- ☐ Yes ☐ No

- 11) Does your State plan to implement ADS-B ?

Yes When: 2013

- 12) Does your State plan to implement Multilateration -- ☐ Yes When _____ ☐ No

- 13) What is the Status of the following systems in your State

a. ADS-C -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

b. CPDLC -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

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- 14) Does your State have any plans to implement augmentation systems

a. SBAS : No

b. GBAS : Yes When : 2016

- 15) What role would your State like ICAO to assume in your GNSS Programme

For all our future GNSS Program, we like to have full co-operation from ICAO.

- 16) Any comments

NIL

- END -

APPENDIX B

GNSS ASSESSMENT SURVEY

The following GNSS survey has been developed by ICAO to assess the Regional (Global) level of GNSS implementation and to determine the role that States would like ICAO to assume

Please return the completed survey to icaomid@cairo.icao.int by 30 June 2012

State Name: OMAN

Contact Name:

Contact email:

- 1) Has your State developed a plan to implement GNSS -- ☒ Yes ☐ No
- 2) Was the GNSS Manual (Doc 9849) used as a reference when considering the implementation of GNSS ☒ Yes ☐ No
- 3) Has the basic GNSS regulation been promulgated in your State -- ☒ Yes ☐ No
- 4) a- Has your administration received requests from domestic aircraft operators to provide GNSS-based services -- ☒ Yes ☐ No
b- Has your administration received requests from international aircraft operators to provide GNSS-based services -- ☒ Yes ☐ No
- 5) What is the level of WGS - 84 survey completion in your State
 - a. For Waypoints -- 100%
 - b. For Airports -- 100%
- 6) What percentage of aircraft are equipped with GNSS avionics 100%
- 7) a- What is the number of runways in your State that meet instrument standards but do not have an instrument approach 3
b- What is the number of runways in your State that are only served by a circling procedure NONE
- 8) In your State, how many PBN approach procedures are promulgated based on
 - a. GNSS -- 6
 - b. Conventional navigation-aids NONE
- 9) How many ILS systems are equipped with marker beacons only (no DME) for aircraft to perform altitude/distance cross checks? NONE

10) Do you allow the use of FMS GPS based computed distance checks? --☒ Yes ☐ No

11) Does your State plan to implement ADS-B --☒ Yes When 2015 ☐ No

12) Does your State plan to implement Multilateration --☒ Yes When 2015 ☐ No

13) What is the Status of the following systems in your State

- a. ADS-C -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No
b. CPDLC -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

.....

14) Does your State have any plans to implement augmentation systems

- a. SBAS -- ☐ Yes When ☒ No
b. GBAS -- ☒ Yes When 2016 ☐ No

15) What role would your State like ICAO to assume in your GNSS Programme

ADVISORY

16) Any comments

-END-

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ATTACHMENT A
STATE LETTER REF: AN 6/28-12/216

GNSS ASSESSMENT SURVEY

The following GNSS survey has been developed by ICAO to assess the Regional (Global) level of GNSS implementation and to determine the role that States would like ICAO to assume

Please return the completed survey to icaomid@cairo.icao.int before 1 September 2012

State Name: Jordan

Contact Name: Eng. Amer Al-Jahmi

Contact email: a_jahmi@yahoo.com; Amer.jahmi@carc.gov.jo

- 1) Has your State developed a plan to implement GNSS -- ☒ Yes ☐ No
- 2) Was the GNSS Manual (Doc 9849) used as a reference when considering the implementation of GNSS ☒ Yes ☐ No
- 3) Has the basic GNSS regulation been promulgated in your State -- ☐ Yes ☒ No
- 4) a-Has your administration received requests from domestic aircraft operators to provide GNSS-based services -- ☐ Yes ☒ No
b-Has your administration received requests from international aircraft operators to provide GNSS-based services -- ☐ Yes ☒ No
- 5) What is the level of WGS - 84 survey completion in your State
 - a. For Waypoints -- 100 %
 - b. For Airports -- 100 %
- 6) What percentage of aircraft are equipped with GNSS avionics -- Statistics process under development
- 7) a- What is the number of runways in your State that meet instrument standards but do not have an instrument approach 1
b- What is the number of runways in your State that are only served by a circling procedure - 1
- 8) In your State, how many PBN approach procedures are promulgated based on
 - a. GNSS -- 0
 - b. Conventional navigation-aids -- 0
- 9) How many ILS systems are equipped with marker beacons only (no DME) for aircraft to perform altitude/distance cross checks? -- 0 (Markers will be replaced by DME within 6 months)

10) Do you allow the use of FMS GPS based computed distance checks? -- ☒ Yes ☐ No

11) Does your State plan to implement ADS-B -- ☒ Yes When - 2012 ☐ No

12) Does your State plan to implement Multilateration -- ☒ Yes When - within 5 years ☐ No

13) What is the Status of the following systems in your State

a. ADS-C -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

b. CPDLC -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

14) Does your State have any plans to implement augmentation systems

a. SBAS -- ☐ Yes When _____ ☒ No

b. GBAS -- ☒ Yes When 2015 ☐ No

15) What role would your State like ICAO to assume in your GNSS Programme

A) To expand EGNOS service to cover Jordan.

B) To standardize training of GNSS

C) To provide states with best practice GNSS Implementation worldwide.

16) Any comments

- END -

GNSS ASSESSMENT SURVEY

The following GNSS survey has been developed by ICAO to assess the Regional (Global) level of GNSS implementation and to determine the role that States would like ICAO to assume

Please return the completed survey to icaomid@cairo.icao.int before 1 September 2012

State Name: State of Qatar

Contact Name: Faisal Alqahtani

Contact email: Faisal.Alqahtani@caa.gov.qa

- 1) Has your State developed a plan to implement GNSS -- ☒Yes ☐No
- 2) Was the GNSS Manual (Doc 9849) used as a reference when considering the implementation of GNSS ☒Yes ☐No
- 3) Has the basic GNSS regulation been promulgated in your State -- ☐Yes ☒No - ICAO Document used as reference
- 4) a-Has your administration received requests from domestic aircraft operators to provide GNSS-based services -- ☒Yes ☐No

b-Has your administration received requests from international aircraft operators to provide GNSS-based services -- ☒Yes ☐No
- 5) What is the level of WGS - 84 survey completion in your State
 - a. For Waypoints -- 100%
 - b. For Airports -- 100%
- 6) What percentage of aircraft are equipped with GNSS avionics +85%
- 7) a- What is the number of runways in your State that meet instrument standards but do not have an instrument approach Nil

b- What is the number of runways in your State that are only served by a circling procedure Nil
- 8) In your State, how many PBN approach procedures are promulgated based on
 - a. GNSS - 4
 - b. Conventional navigation-aids - 15
- 9) How many ILS systems are equipped with marker beacons only (no DME) for aircraft to perform altitude/distance cross checks? Nil

10) Do you allow the use of FMS GPS based computed distance checks? -- ☐ Yes ☒ No -- For
Landing Procedures

11) Does your State plan to implement ADS-B -- ☒ Yes When 2010 ☐ No

12) Does your State plan to implement Multilateration -- ☒ Yes When _____ ☐ No

13) What is the Status of the following systems in your State

a. ADS-C -- Equipped ☐ Yes ☒ No Operational ☐ Yes ☒ No

b. CPDLC -- Equipped ☒ Yes ☐ No Operational ☒ Yes ☐ No

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14) Does your State have any plans to implement augmentation systems

a. SBAS -- ☒ Yes When 2022 ☐ No

b. GBAS -- ☒ Yes When 2022 ☐ No

15) What role would your State like ICAO to assume in your GNSS Programme
Oversight only

16) Any comments

No.

- END -