



International Civil Aviation Organization

**MIDANPIRG Communication Navigation and Surveillance
Sub-Group (CNS SG)**

Fourth Meeting
(Cairo, Egypt, 25 – 27 September 2011)

Agenda Item 5: Developments in CNS Field

OUTCOME OF NAVIGATION SYSTEMS PANEL (NSP) MEETINGS

(Presented by Secretariat)

SUMMARY

This paper provides significant outcomes of the two meetings of the ICAO Navigation Systems Panel (NSP) meetings in November 2010 and May 2011 to progress on the implementation of global navigation system for aviation.

Action by the meeting is at paragraph 3.

REFERENCES

- NSP meeting reports

1. INTRODUCTION

1.1 Navigation Systems Panel (NSP) Working Group of the Whole (WGW), and other NSP working groups and sub-groups met at ICAO Headquarter in Montreal, Canada from 9 to 18 November 2010. Addressing the meeting Mr. Mervyn Fernando, President Air Navigation Commission elaborated following points:

- 1) The need to develop ICAO products leading to implementable resources;
- 2) Need to consider all States: States that have lesser technological capabilities as well as States that have greater capabilities; and
- 3) Need to consider anticipated impact on States because of proposed changes. Chief CNS suggested that NSP should help ICAO to develop a roadmap for avionics equipage. Meeting was informed that a Technology Forum is planned for 21 to 23 September 2011 to get industry inputs.

1.2 Tenth Working Group of the Whole meeting (WGW/10) of Navigation Systems Panel was held in Montreal from 9 to 20 May 2011. The meeting was held along with the subordinate sub-group meetings.

2. DISCUSSION

2.1 Ninth NSP Working Group of the Whole Meeting (November 2010)

2.1.1 *Agenda Item 1: Preparation for the 12th Air Navigation Conference*

2.1.1.1 ICAO Secretariat has identified potential need for holding the 12th Air Navigation Conference (AN-Conf/12) in late 2012 (tentative dates: 19 – 30 November 2012). NSP's contribution to the 12th Air Navigation Conference was envisioned as three papers:

- 1) A paper on rationalization of ground navigation aids
- 2) A paper on GNSS vulnerability
- 3) A on maximizing the benefits of multi-frequency, multi-paper constellation GNSS solution

2.1.1.2 A suggestion was made for an additional paper discussing the implementation issues like: *aircraft operators require an expectation of incremental benefits before investing in new avionics and, on the other hand, service providers struggle to secure the funding needed to implement new services in spite of the fact that no or few aircraft are equipped to take advantage of the new services.*

In the subsequent meeting NSP decided to draft five papers for presentation to the Conference.

2.1.2 *Agenda Item 2: SARPs for GNSS elements and signals (ABAS, SBAS and core Constellation)*

2.1.2.1 Secretariat explained that Amendment 86 to Annex 10, which includes GBAS maintenance changes had been circulated for States' comments. Changes subsequently adopted in NSP WGW meetings held in May and November 2010 will be included in the next Amendment (Amendment 87). Meeting discussed some outstanding issues related to Standard Positioning System (SPS) Performance Standards. Amendment to GLONASS SARPs was discussed and the results of experimental assessment of actual GLONASS accuracy for the period from September 2009 was reviewed.

2.1.2.2 It was informed that the OS ICD for Galileo had been published and is available for download from the website for the guidance of the receiver manufacturers. On the issue of reaping the benefits of combined use of GPS and Galileo satellites from the first batch of qualified Galileo satellites, the meeting was informed that a study showing the benefits of an incremental addition of Galileo Satellites to GPS constellation based on combined RAIM was undergoing and initial results had been presented to EUROCAE.

2.1.2.3 Proposal for change of SBAS SARPs concerning ionospheric algorithm was presented by India. Amendment to SARPs in Annex 10 were proposed to introduce limited GAGAN related material. This proposal included a GAGAN service provider ID in Table B-27 and some material in Attachment D. GAGAN requirements specify a 6 seconds time-to-alert, while APV1 is characterized by a 10 seconds time-to-alert. This improvement was termed as APV1.5. A major area of work for GAGAN was in the area of selecting an appropriate ionospheric algorithm that will meet the requirements of Annex 10 without involving any modification to the standards in RTCA MOPS. GAGAN Algorithm Working Group has evaluated algorithm options and selected the Multi Layer Data Fusion (MLDF) model for implementation.

2.1.2.4 NSP WGW meeting (May 2010) raised a concern that the number of pseudorandom noise (PRN) codes allocated for SBAS and currently available for use was not adequate to support SBAS being developed and proposed for standardization. Proposal to allocate additional PRN codes for SBAS was not supported by RTCA due to backward compatibility with PRN beyond the range of 120 to 138 currently specified in SBAS SARPS. There was a general agreement that the issue did not require an immediate solution, however it will be necessary to keep track in order to ensure that action can be taken promptly if it becomes clear that the 19 PRNs will not be sufficient to address future need.

2.1.2.5 Discussing inconsistent interpretation of requirements regarding the use of GEO almanac and ephemeris data by EGNOS developers and users' equipment manufacturers, SBAS avionics equipment was sometimes rejecting EGNOS GEO source for valid data. This issue is related to the data in Message Type 17(MT 17) for almanac and Message Type 9 (MT9) for ranging. Thought it is not a safety issue but it may affect inter-operability. It was suggested that a thorough review of SBAS SARPs should be carried out to identify modifications that will be required in order to mandate consistency between MT9 and MT17 information.

2.1.2.6 There was a proposal to review NSP paper (2006) on ionospheric effect on GNSS with a view to update it to account for new results and information gained. Since solar cycle is expected to peak in 2013, it was proposed that the paper be updated by the end of 2011. This would be helpful to address concerns with the expected increased solar activity and its potential effect on GNSS. Impact of solar bursts on GNSS, it was informed, is not covered in the existing Manual. It was agreed that a section on this information will be included in the revision. It was suggested that the progress made in the development of a GBAS ionospheric threat model should also be captured in the NSP paper.

2.1.2.7 It was agreed that ICAO should take responsibility for SBAS channel assignments and this would involve delegation of some responsibility to ICAO Regional Offices. It was commented that allocating blocks of contiguous codes to ICAO Regional Offices will not be possible given the number of codes already assigned and then need to have channels allocated with sufficient dissimilarity within the same region (to minimize the risk of confusion between channels). A suggestion was made that the Secretariat should develop an operational concept paper to describe responsibilities (for ICAO HQ, ICAO Regional Offices and States), processes and procedures.

2.1.2.8 Meeting was informed that Inter-operability Working Group (IWG) has decided to develop a definition document for SBAS dual-frequency multi-constellation services.

2.1.3 *Agenda Item 3: SARPs for GNSS elements and signals (GBAS)*

2.1.3.1 Issues concerning the outcome of State Letter on GBAS Approach Service Type D (GAST D) and baseline SARPs material for GBAS CAT II/III were discussed. No reportable outcome could be achieved.

2.1.4 *SARPs for Conventional Radio Navigation Aids*

2.1.4.1 It is anticipated that new criteria for Critical and Sensitive Areas (CSAs) will potentially impact the operations, which will be further restricted by new requirements associated with large airframes that did not exist when the existing requirements were established. It was agreed that the issue of protecting the approaching aircraft at 200 feet above threshold or up to 2 nm out is required to be coordinated with the Operations Panel.

2.1.5 *Agenda Item 5: Update to ICAO Doc 8071*

2.1.5.1 Issues related to transferring materials related to flight validation and restructuring of the document were deliberated in the meeting.

2.1.6 *Agenda Item 6: Guidance on Operational Implementation Issues*

2.1.6.1 On the subject of update to the GNSS Manual, following topics were recommended for inclusion:

1. Treatment of GNSS repeaters
2. Approach classification renaming
3. Definition of GNSS anomaly
4. GNSS cost recovery
5. Vulnerability of GNSS to solar radio bursts
6. NSP Documents on Ionospheric Effects
7. RAIM availability predictions
8. Introduction of SBAS Procedures in the UK
9. GNSS continuity of service requirement

2.1.6.2 Meeting reviewed the update proposal for GNSS Manual (Doc 9849) which addresses operational implementation hurdles and places GNSS implementation in the context of PBN implementation and other initiatives in the Global Air Navigation Plan (Doc 9750). Many States, in their comments on the revised GNSS Manual requested additional material on GNSS Safety Case and Business case.

2.1.6.3 The meeting noted that many States did not have formal GNSS operational approval rules in place. In addition, the implementation of PBN requires specific State rules to facilitate regulation that would include GNSS material.

2.1.7 *Interference*

2.1.7.1 GNSS repeaters are used for various commercial and consumer applications, for example they are used in avionics maintenance facilities to provide onboard avionics with real time GNSS position information within a maintenance hangar. Meeting felt that regulations need to be in place to prevent harmful interference to other aviation applications from these repeaters. It was noted that interference from unauthorized devices (e.g. personal jammers dedicated to privacy protection), as well as from authorized devices (e.g. repeaters or pseudolites) used without adequate protective measures, has become a growing problem. It was suggested that limiting transmit power of repeaters so as to limit interference to 30 to 40 feet might provide a partial solution to the problem. However this would not work for mobile jammers, since even a small unauthorized radiating element would likely disallow the use of GNSS on-board an aircraft when the 'privacy controlling' jammer was left operating during the flight. It was also noted that the accumulated effect from the proliferation of multiple devices in close proximity would also be a problem. It was explained that currently a GBAS station installed in the United States close to a parking lot had its interference monitor triggered up to several times per week by GPS jammers installed in the cars. Mitigation against the potential proliferation of low cost GPS jammers to protect privacy has not been planned. It was agreed that this threat in addition to the potential proliferation of pseudolites has greatly raised concern of the communities. Some States informed that strong regulatory measures have been taken by their administration and operating a jammer in their State could even lead to a jail term. It was suggested that NSP should prepare a white paper on this issue and a summary of this paper should be presented to the next Air Navigation Conference. It was also agreed that a letter will be circulated on the subject.

2.1.8 *Approach Classification Renaming*

2.1.8.1 The classification of APV was introduced in 2003 as an additional classification between NPA and PA, since the approaches being envisaged did not readily fit into either one of the two existing classification. Meeting noted that Air Navigation Commission has created Approach Classification Task Force (ACTF) in 2009 to review the approach classification scheme because the term APV was found to be causing some confusion (e.g. Annex 14 dealing with aerodromes does not address APV). Meeting felt that by the time the revised approach classification system is finalized, APV will be embedded in many ICAO and State documents and it will become very difficult to change the terminology then. Meeting was also informed that ICAO Assembly Resolution on PBN, apart from changing some of the PBN implementation dates, also included a recommendation that States develop LNAV procedures along with LNAV/VNAV to ensure the safety benefits of straight in approaches realized.

2.1.8.2 Meeting desired to know the definition of “basic GNSS services” as this has a legal implication in drawing a limit between services that must be provided free of charge and more advanced services for which the cost of services can be charged. It was mentioned that one should not assume that the development costs of an SBAS or GBAS implementation will necessarily be recovered from users in most cases, and hence it was suggested that “most cases” should be replaced with “some cases” in the definition. It was commented that “open services” are provided by core constellations, and their development and implementation costs cannot be recovered because of the reason that these provide service to a variety of user communities and a cost allocation between the different user communities would not be feasible. It was noted that “open services” term is used by Galileo and there is no corresponding definition in ICAO documents.

2.1.9 *ICAO SARPs*

2.1.9.1 It was expressed that operational aspects of continuity of service and current risk requirements for APV may have been set to an unnecessarily small value, posing a potentially costly implementation problem for SBAS and causing difficulties for gaining the approval of APV service in some States. A review of the requirement, which was originally set on the basis of requirements imposed on ILS, rather than on an analysis of actual operational requirements, was recommended. It was also suggested that methodologies to evaluate continuity performance be harmonized among service providers. It was however expressed that, depending upon a number of conditions, some airports may require a high continuity of service, while other airports may be able to operate with a lower continuity of service. It was pointed out that, while missed approaches are not safety concerns, they result in operational disruptions and they represent economic concerns to aircraft operations. It was therefore expressed that ILS would need to be retained at all runways for which a certain level of continuity of service needs to be assured. Earlier, on this issue Working Group of the Whole had arrived at a conclusion that it was appropriate to keep the current ILS Cat I equivalent continuity requirement as a target for system designer. Achieving this continuity figure had been demonstrated as feasible and was currently achieved by WAAS and EGNOS.

2.1.10 *Agenda Item 7: Status of GNSS elements and signals*

2.1.10.1 In August 1999, Russian Federation offered the services of Global Navigation Satellite System (GLONASS) free of charge to the international aviation community. Following the launch of three GLONASS-M satellites, the constellation remains at the nominal strength of twenty four satellites. Launch of first experimental GLONASS-K, which will broadcast new code division multiple access (CDMA) signal in L3 band was slated for December 2010. The ultimate plan for GLONASS is to gradually introduce CDMA signals in the L1 and L3 bands, while retaining the existing signals.

2.1.10.2 It was informed that one WAAS GEO (Galaxy 15) had a total failure of its Telemetry, Tracking and Control unit in April 2010. The satellite is currently drifting eastward, but it still is providing WAAS service. FAA is procuring two new GEOs, one as a gap filler to bridge the gap and the other as a replacement satellite for Galaxy 15. Meeting was also informed about WAAS Phase III programme, which includes technology refresh and a new ionospheric delay estimation algorithm based on Kriging model. FAA has also started initial planning for the development and implementation of WAAS enhancements to support dual frequency (L1/L5) service.

2.1.10.3 Meeting was informed about the final rule published by FAA on May 28, 2010 concerning Automatic Dependent Surveillance – Broadcast (ADS-B) Out. The final rule specifies equipage requirements and performance standards for ADS-B Out for aircraft operating in Class A, B and C airspace as well as other specified classes of airspace. The compliance date for the final rule is January 1, 2020. It requires Navigation Integrity Category (NIC) of 7 or better, which corresponds to a containment radius of 0.2 NM or less.

2.2 Tenth Working Group of the Whole (WGW/10) meeting of NSP

2.2.1 Briefing on Aviation System Block Upgrades to provide roadmap for the guidance of the stakeholders to help them in making their investment decisions regarding CNS equipage was provided to the meeting. It has been decided to develop the programme by taking advantage of the similar programmes that are already in place (e.g. SESAR in Europe and NexGen in US) and build the roadmap on the basis of common elements in these programmes. It is decided to develop the roadmap in terms of building blocks representing sets of capabilities. Block 0 identifies the existing capabilities, while Blocks 1 to 4 include new capabilities to be developed over time. It was decided that the Block Updates will be discussed during Global Air Navigation Industry Symposium (GANIS), scheduled to be held in September 2011.

2.2.2 *Agenda Item 1: Preparation for the 12th Air Navigation Conference*

2.2.2.1 Meeting was informed about the State Letter dated 31 March, 2011, through which comments on the proposal to hold an air navigation conference and the recommended topics were invited. It was decided that NSP would prepare following papers on behalf of the Secretariat for presentation to the Conference:

- Rationalization of ground based navigation aids
- GNSS vulnerabilities/mitigations
- Maximization of benefits from multi-frequency, multi-constellation GNSS solution
- GNSS implementation
- Navigation Roadmap

2.2.3 *Agenda Item 2: SARPs for GNSS elements and signals (ABAS, SBAS and core constellation)*

2.2.3.1 Amendments were proposed to align ICAO SARPs with the GPS Standard Positioning Service (SPS) Performance Standards (PS) published in 2008. Proposal focused on major service failure standards and introduced new category of satellites called marginal satellites.

2.2.3.2 Through an experimental assessment of GLONASS performance, it has been confirmed that the performance is well within the SARPs requirement. Implementation of CDMA in GLONASS includes a new signal in the L3 band on a carrier frequency of 1202.025 MHz. Information on GLONASS L3 will be placed on the website: <http://spacecorp.ru>. Full constellation broadcasting L3 signal is likely to be available after 2020 only.

2.2.3.3 SBAS channel allocation schema for globally or regionally unique SBAS channel assignment was also presented to the meeting. It was agreed that as a first step, allocation of globally unique number for each SBAS procedure will be attempted. Secretary assured to provide further and firmer information on the schedule for delivering the new capability at the next NSP meeting and earlier if possible.

2.2.3.4 Meeting recommended removal of the phrase “and Time to Alert” from the title of Attachment D. 3.3 Annex 10 in view of the fact that the section is not covering this issue. Changes to the SARPs to align them with other relevant Standards like MOPS etc. were also proposed and it was decided that wordings of the updated SARPs should be coordinated with RTCA SC-159 before they are adopted. Issues related to the continuity requirement were also discussed, but no final decision was reached.

2.2.4 *Agenda Item 3: SARPs for GNSS elements and signals (GBAS)*

2.2.4.1 Reports on GBAS programme in US, Brazil, Japan, Singapore, Spain, France, Germany, Eurocontrol and implementation information by Northrop Grumman, Thales and Boeing were presented.

2.2.5 *Agenda Item 4: SARPs for conventional radio navigation aids*

- Eurocontrol has developed a software package DEMETER to support PBN infrastructure assessments and is available as open source software;
- After discussing the error budget for DME/DME supporting RNP 0.5, it was agreed that the transponder specifications can be tightened to improve the ability of DME/DME calculations to support RNP 0.5.;
- Critical and Sensitive Areas (CSAs) for ILS have been discussed in the NSP for a long time. Ultimately it has now been decided to leave the definition unchanged and revise the dimensions using the existing definitions;
- It has been decided to complete the guidance material for Localizer in view of operations with large aircraft (e.g. A380).

2.2.6 *Agenda Item 5: Updates to Doc 8971*

2.2.6.1 It has been proposed to restructure Doc 8071 in view of removal of flight validation material from Volume 2 and the remaining material in the document getting too small to justify a full volume. It is being proposed to integrate Doc 8071 Volume 1 and 2. Meeting was reminded that VOR is no longer being used only for radial navigation, it is also being used for area positioning system along with DME and hence this needs to be addressed in Doc 8071.

2.2.7 *Agenda Item 6: Spectrum (except WRC issues)*

2.2.7.1 Meeting reviewed paper submitted on signal and compatibility issues in the band 108 to 117.975 MHz, in the band 960 to 1215 MHz, 5000 to 5150 MHz and GNSS signal and interference issues, but no significant outcome was recorded.

2.2.8 *Agenda Item 7: Guidance on operational implementation issues*

2.2.8.1 Draft updates to the GNSS Manual (Doc 9849) were reviewed by the meeting and the draft was revised. It was concluded that the document should include the following:

- State AICs or other documents approving these services
- Business case and safety case documents
- Information material
- Aircrew and ATC training material; and
- State standards document for avionics, survey, procedure design etc.

2.2.8.2 It was informed that hurdles identified by regional offices have been addressed in the updated document.

2.2.8.3 Meeting was informed about a low cost GPS device called 'AWARE' developed jointly by UK Air Navigation Service Provider (NATS) and an equipment company (Airbox) which provides warning to general aviation pilots if they are approaching or entering controlled or restricted airspace. It was informed that airspace infringement occurs when aircraft flying in non-controlled airspace accidentally enters controlled airspace and this represents a significant safety hazard. Developers of AWARE claimed that this tool has made a significant contribution by way of a 35% reduction in infringements and a 40% reduction of infringement risk and have won three prestigious awards for this innovative development.

2.2.9 *Agenda Item 8: Status of GNSS elements and signals*

2.2.9.1 Meeting was informed about the declaration of EGNOS Safety of Life (SoL) service, the publication of EGNOS SoL service definition, the initial NOTAM service provision and future EGNOS system releases. Progress made in the promulgation of LPV procedures in Europe was also informed.

2.2.9.2 Indian SBAS GAGAN with 15 reference stations, 3 master stations and GSAT8 (and proposed GSAT10 and GSAT9) as the space segments is in the final phase of testing. First milestone will be to deliver RNP 0.1 capability over Indian FIR, second milestone is planned to deliver APV-I service over 90% of Indian land mass. Plan is to certify GAGAN for RNP 0.1 service by the end of 2012 and for APV-I service by June 2013. Operational service (removal of MT0) will be declared in 2013. India has opened discussions with neighboring countries to encourage them to participate in the GAGAN project by installing reference stations (to be integrated in the project). On the question of liability for signal in space outside India, it was noted that SBAS service providers have arranged cross border arrangements. Subsequently, the meeting was informed that Nav Canada has a formal agreement with FAA for the provision of WAAS services. Nav Canada is liable for WAAS-based operations in Canada (unless an accident is found to be the result of FAA negligence), and has a very large insurance coverage for its liability. Complexity of liability issues were further discussed in the meeting, but no significant outcome could be achieved. India also informed about the ionospheric model being developed specifically for its airspace. The Meeting was also informed about the progress of Russian SBAS programme.

2.2.10 *Agenda Item 9: Recommendations by WGW of SARPs changes*

2.2.10.1 Proposed additions to the guidance material provided in Attachment D to Annex 10, Volume I was agreed to. Meeting noted the inconsistency between the RVR values required for Category II and Category III (A/B) operations as provided in Annex 10 and Annex 6 & 14 and agreed to update information in Annex 10 to remove the inconsistency.

2.2.11 *Agenda Item 10: Other issues*

2.2.11.1 NSP agreed to propose a draft SL for ICAO's consideration warning the States about the harmful effect of interference on GNSS performance. Meeting was informed about the status of repeater implementation and the threat of interference because of such implementations. Updates on NSP Paper "Ionospheric Effects on GNSS Aviation Operations" were discussed and modified based on the discussions.

2.2.11.2 Transition strategy to the sole satellite-based navigation service was revisited and issues involved like business sense in migrating when the existing infrastructure provides sufficient level of service etc. were also considered. Meeting was of the view that such issues including different States adopting different approaches need to be raised in the 12th Air Navigation Conference.

2.2.11.3 While discussing optimizing DME locations to provide DME/DME service, the meeting was informed about UK plans to start decommissioning VORs in 2012. Meeting was also informed about UK consultation document “Enabling UK growth – Releasing public spectrum” and the threat it is causing to the spectrum used for civil aviation. It was predicted that incentive pricing may force aviation to use spectrum more efficiently and it was recommended that aviation should develop a plan to become more efficient and respond to potential complaints from other spectrum users.

2.2.12 *Agenda Item 11: Future work*

2.2.12.1 Meeting scheduled earlier for September 2011 was re-scheduled to 5 to 16 December 2011.

3. ACTION BY THE MEETING

3.1 The meeting is invited to note the information in this information paper.

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