

May 1999

GNSSP-3 (report of Heinz Lichius to IBAC)

On 30 November 1993 the Air Commission (ANC) established the Global Navigation Satellite System Panel (GNSSP) with the following terms of reference and work program:

To undertake specific studies, as approved by the Air Navigation Commission and reflected in the work program of the panel, with a view to advising the ANC on technically practical and operationally feasible ICAO provisions, as necessary, to meet the objectives specified in the work program.

The third meeting of the Global Navigation Satellite System Panel (GNSSP) was opened by Mr. V.M. Aguado, President of the Air Navigation Commission in Montreal at 1100 hours on 12 April 1999.

This meeting was attended by members nominated by twenty-one Contracting States and eleven international organizations, as well as by observers and advisers.

Mr. W. Bellen, the German representative, was elected Chairman and the Secretary of the meeting was Mr. V. Latsouk, Technical Officer of the CNS Section of the ICAO.

Interpretation and translation was in English, French, Russian and Spanish and was provided by the Language Branch.

The meeting recalled that the GNSS Standards and Recommended Practices (SARPs) had been under development since the first meeting of the GNSS Panel (GNSSP/1) held in Montreal in 1994. In the development of draft SARPs, interoperability was a major concern from two aspects. It was necessary to accommodate existing and emerging technology variations to ensure a global, seamless implementation. It was also necessary to ensure that the different elements were able to work together and to minimize the amount of avionics required to support the use of GNSS. The meeting was made aware that the applicability date for the SARPs is planned for November 2000, and SARPs adoption by the Council is expected in March 2000. It was recommended that ICAO ANNEX 10, Volume 1 be amended to incorporate Standards and Recommended Practices (SARPs) for global navigation satellite system (GNSS).

A dedicated Working Group (A) developed and proposed requirements for **Ground Recording of GNSS Data**. The meeting was informed that these requirements for ground recording of GNSS signal was originated in the Panel of Legal and Technical Experts on the Establishment of a Legal Framework with regards to GNSS (LTEP) which stated that *with regard to liability portion, signal should be recorded for purposes of evidence in accordance with ICAO SARPs*. The need for amendment to Annex 10 to introduce requirements for ground recording was discussed and confirmed by Working Group A. It was agreed that this amendment would be included in Chapter 2 of Annex 10.

The meeting received a presentation developed by Working Group C, containing draft "guidelines for the long-term GNSS". Having agreed that this document would be used as a basis for the panel report to the ANC, the meeting addressed a number of issues related to **evolution of GNSS**, and ICAO work needed to support this evolution. It recognized the recent developments, including the proposed GPS L5 signal and the new navigation satellite constellation **Galileo**. The meeting appreciated information on the development of this constellation, since this was intended to become a key element of the Trans-European Network (TEN) for navigation and positioning

services and a new element of GNSS. It was noted that the final decision of the Transport Council of the European Union in regard to the project is expected in mid 1999, and subject to this decision, the Galileo definition phase would start with a target completion date in December 2000. The meeting was made aware that the European Union planning for Galileo suggests that the system should be developed in a manner that would ensure that Galileo could be incorporated in and function as an element of the worldwide GNSS. It is proposed that Galileo be the European contribution to the long-term GNSS aimed at providing Europe with the capability to deliver world-wide satellite based navigation services through a constellation of 21 to 36 Medium Earth Orbit satellites. There would be a basic navigation service, the performances of which would be similar to those announced for GPS Bloc 11F, with an open access signal and without direct user charges. In addition to the basic Galileo navigation service, it is planned to provide other services, similar in terms of technical performances although fully certifiable, for which Galileo service provider would accept full liability. These services are aimed at supporting safety critical applications such as civil aviation operations. Access to those services would be subject to user charges and restrictions through signal encryption. Although clearly independent from GPS, Galileo will be compatible and interoperable with GPSI. It is proposed to start the operational service of Galileo in 2008.

It was also observed that the proposed "Guidelines for the long-term GNSS" stress the importance of ICAO coordination with various parties involved in GNSS development and implementation, the **IMO** being one of the most active international organizations in this area. Information was also provided on the outcome of discussions in GNSSP Working Group **B** and the support developed by the group in favor of the formation of an ICAO/IMO joint planning group on GNSS and recommended *that ICAO Secretariat coordinate common GNSS issues with IMO.*

GNSS radio frequency issues:

The GNSS elements GPS, GLONASS, SBAS, GBAS and associated radio frequency bands are defined in the draft GNSS SARPs. The operation of the present GNSS elements is primarily based on the availability of the 1 559 to 1 610 MHz ARNS band. It is extremely important that this core frequency band of GNSS is protected. It is expected that ICAO and all interested parties will continue to defend this band.

Use of GNSS as sole means of navigation:

The meeting recalled that the terms "supplemental-means", "primary-means" and "sole-means" navigation system had been introduced by the Special Committee for Monitoring and Coordination of development and Transaction Planning for the Future AirNavigation System (FANS Phase II) and further developed by the GNSS Panel. The terms are explained in the ICAO Guidelines for the Introduction and Operational Use of Global Navigation Satellite System (Circular 267) and are also described in more general terms in Section 6.7 of the ICAO Global Air Navigation Plan for CNS/ATM Systems. The terms were initially intended to provide a common basis for:

evolutionary implementation of GNSS; and

approvals of GNSS-based operations

The meeting observed that the second goal had not been achieved due to different interpretations of terminology and the lack of uniformity in authorizations issued in various States for GNSS-

based operations. Suggestions were also made to discontinue the use of their terms, although they were not fully supported in view of already widespread usage of this terminology.

States Approvals:

The use of GPS has been approved for aircraft navigation purposes in a number of States including: Argentina, Australia, Bolivia, Brazil, Canada, Chile, Columbia, Costa Rica, Dominican Republic, Federal States of Micronesia, Fiji, France, Germany, Iceland, Italy, Japan, Morocco, Mexico, New Zealand, Panama, Peru, Republic of Marshall Islands, Republic of Palau, South Africa, Spain, United Kingdom, United States, Uruguay and Venezuela.

Approval for GPS to be used for Basic Area Navigation (BRNAV) in Europe (ECAC) has been in existence since 1998.

The levels of operational approvals differ from State to State and include en-route, terminal, non-precision approach, and SCAT-1.

To support current GPS approvals, a number of States (such as Australia, Germany and the United States) have implemented GPS availability prediction systems for en-route and/or non-precision approaches. These are required to inform pilots of limitations in the availability of a suitable level of GPS performance for the phase of flight.

In accordance with ICAO provisions and to cover GPS IFR operations, some States have also provided a GPS NOTAM service, based on the United States Coast Guard NANU (Notice Advisory to Navstar Users). In some cases the prediction programs used to validate oceanic and remote area GPS operations electronically use this information.

References to CNS/ATM:

The global navigation satellite system (GNSS) should be implemented as an evolutionary progression from existing global navigation satellite systems, including the United States' global positioning system (GPS) and the Russian Federation's global orbiting navigation satellite system (GLONASS), towards an integrated GNSS over which Contracting States exercise a sufficient level of control on aspects related to its use by civil aviation. ICAO shall continue to explore, in consultation with Contracting States, airspace users and service providers, the feasibility of achieving a civil internationally controlled GNSS.

GNSS Augmentations:

For **Ground-based augmentation system** (GBAS), a monitor is located at or near the airport where precision operations are desired. Signals are sent directly to the aircraft in the vicinity (approximately 37-km (20 NM)). These signals provide corrections to increase the position accuracy locally along with satellite integrity information. This capability requires data link(s) between ground and aircraft.

Satellite-based augmentation (SBAS). It is not practical to provide coverage with ground-based systems for all phases of flight. One way to provide augmentation coverage over large areas is to use satellites to transmit augmentation information i.e. SBAS.

Avionics: Simple GPS or GLONASS receivers that do not include RAIM capability (or similar forms of integrity monitoring) generally cannot meet requirements for all phases of flight.

Multi-sensor systems, using GNSS as one of the sensors, are expected to be in use for the foreseeable future. Such navigation systems generally exhibit better levels of performance than the individual sensor or stand-alone systems. Aircraft using multi-sensor navigation systems, such as integrated GNSS/IRS or GNSS/IRS/FMS, may be certified as meeting levels of RNP which could not be obtained by use of GPS or GLONASS alone.

Evolutionary Introduction:

GNSS implementation will be carried out in an evolutionary manner, allowing gradual system improvements to be introduced. Near-term applications of GNSS are intended to enable the early introduction of satellite-based-on-route navigation, using the existing satellite systems (GPS and GLONASS) and primarily aircraft-based augmentations.

Medium-term applications will make use of existing satellite navigation systems with any augmentation or combination of augmentations required for operation in a particular phase of flight. Longer-term applications will apply to future GNSS.

Three levels are generally accepted for introduction of GNSS-based operations:

Supplemental-means GNSS must meet accuracy and integrity requirements for a given operation or phase of flight; availability and continuity requirement may not be met. Other navigation systems supporting a given operation or phase of flight must be on board;

Primary-means GNSS must meet accuracy and integrity requirements, but need not meet full availability and continuity of service requirements for a given operation or phase of flight. Safety is achieved by limiting operations to specific time periods and through appropriate procedural restrictions. Other navigation systems can be retained on board to support the primary means GNSS;

Sole-means GNSS must allow the aircraft to meet, for a given operation or phase of flight, all four: accuracy, integrity, availability and continuity of service requirements.

General Transaction Issues:

Guidelines for transaction to the future systems encourage equipage by users for the earliest possible accrual of systems benefits. Although a transition period of equipage, both airborne and ground, is necessary to ensure the reliability and availability of a new system, this period should be limited to the extent practicable.

Review Of Proposals For Future Work:

The meeting discussed two proposals to include the development of SARPs for ground-based regional augmentation system (GRAS) in its future work program. Such systems were proposed to support en-route operations through to non-precision approach in areas where it is not possible, for various reasons, to use SBAS. The meeting agreed that the development of SARPs for ground-based regional augmentation system can be included in the future work program. However, it considered that only one form of GRAS should be standardized, and the SARPs for this should be developed to extend the existing GBAS SARPs to support application for en-route and terminal area operations.

The meeting considered a proposal to include the development of the draft ICAO position on use of 5 091 – 5 150 MHz band by fixed satellite services in the future work program. In preparation for WRC-2003, early 2002 should be kept in mind as a target date for the panel's input to the ICAO position at the conference.

It was noted that in future work it would be necessary to study the effect of the proposed GPS L5 frequency on other aeronautical radionavigation services worldwide.

The meeting re-confirmed that its ongoing task to develop material to protect the GNSS spectrum would continue and expand as necessary to cover emerging elements and augmentations on GNSS.

The meeting considered that it was appropriate for the future work program to include consideration of issues arising from the transition to GNSS, and to provide appropriate guidance to the States. The meeting noted once again that some of these topics would result in a requirement to broaden the expertise currently available in the panel, and this has to be brought to the attention of the Air Navigation Commission when reviewing the proposed revisions to the GNSSP work program.

Working Group A (Operational)

Develop material for inclusion in the appropriate ICAO documents.

Prepare amendments for the above documents.

It was agreed that the first meeting of Working Group A should be tentatively scheduled from 20 to 24 September 1999 in North America at a location to be determined.

Working Group B (Technical)

Develop amendments to SARPs and guidance material for GNSS in Annex 10 on specifically mentioned issues;

Develop material in support of ICAO position in ITU and other forums;

Address compatibility issues associated with co-existence of GNSS and ground-based navigation aids during the transition to satellite-based navigation;

Address technical issues associated with a controlled access service (CAS) and identify institutional issues that may arise in connection with CAS;

The meeting noted that validation activities will continue to remain an inherent part of the SARPs development process though not indicated as a separate work item.

It was agreed that Working Group B will concentrate its activities in 1999 on SARPs validation with a view to concluding this work in January 2000. The SBAS validation sub-group and the GBAS validation sub-group will meet in Washington, D.C., United States, from 14 to 18 June 1999. The full Working Group B (incl., SBAS & GBAS sub-groups and the spectrum sub-group) will meet in Toulouse, France, from 18 to 29 October 1999. Working Group B will then meet from 14 to 29 January 2000 at a location yet to be defined to finish SARPs validation work.

One final recommendation by the panel is that the ICAO make provisions for the convening of the fourth meeting of the GNSSP (2002).