



**ASSEMBLY — 39TH SESSION**

**TECHNICAL COMMISSION**

**Agenda Item 36: Aviation safety and air navigation implementation support**

**FLIGHT SAFETY IMPROVEMENT AS A RESULT OF THE AIRPORT NETWORK  
MODERNIZATION BY INTRODUCING GROUND-BASED DUAL-SYSTEM  
AUGMENTATION (GBAS TYPE) OF THE GLONASS AND GPS SATELLITE  
CONSTELLATIONS**

(Presented by the Interstate Aviation Committee (IAC))

**EXECUTIVE SUMMARY**

This paper provides the summary of positive trends in flight safety improvement as a result of the application of multi-system (GLONASS/GPS) control and augmentation stations (GBAS) for the Global Navigation Satellite System (GNSS).

<i>Strategic Objectives:</i>	This information paper relates to the Safety Strategic Objective.
<i>Financial implications:</i>	No additional sources required
<i>References:</i>	Resolution A36-23 of the 36th Session of ICAO Assembly with guidance materials Doc 9613, <i>Performance-based Navigation (PBN) Manual</i> Doc 9905, <i>Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual</i>

**1. INTRODUCTION**

1.1 At the beginning of the 21st century there was an exigency for the modernization of the national infrastructure of the radio navigation aids (RNA) in the member States of the Agreement on Civil Aviation and Use of Airspace (hereinafter - Agreement). In the course of searching for the possible ways of fulfilling the task the priority was given to the most efficient and prospective technologies, which could provide a complex and simultaneous accomplishment of different tasks. Therefore the attention was mostly focused on the analysis of the deliverables of relevant ICAO working groups and on the States' own technological developments.

<sup>1</sup> English and Russian versions provided by IAC

1.2 As a result of the analysis of possible alternatives the member States decided to put navigation satellite systems (GNSS) into operation as the main navigation and approach aid which is in line with the recommendations and perspective concepts of the States' air navigation system development. In this connection, considering economical expediency and other technical and political factors, the application of dual-system GBAS (GLONASS/GPS) in aviation was given the major priority in the member States of the Agreement in order to ensure the multifunctional use of GNSS. It should be noted that an operator can use the data provided by GBAS from both systems either jointly or separately, from each system. In this case the joint use of the data from GLONASS and GPS seems to be preferable with a view to achieve best characteristics of GBAS.

## 2. DISCUSSION

2.1 For the time being, the samples of joint GLONASS/GPS avionics have been developed and after their tests and certification the serial production of the equipment was launched. About 100 GBAS multi-constellations augmentation stations have been deployed in the member States. These stations were certified by the Interstate Aviation Committee in compliance with the ICAO Standards and Recommended Practices (SARPS): Annex 10, Vol 1, P-4754 (ARP 4754), P-4761(ARP 4761), KT-178B (DO-178B), KT-254 (DO-254), KT-246B (DO-246B), KT-253B (DO-253B), KT-278 (DO-278), KT-160 (DO-160D), technical order ANSP, TSO-C161a, KT-34-01 ed.3, TSO C129A, GLONASS ICD and other requirements. Besides, before the first aircraft were approved to perform regular landing approaches by GLS (GBAS landing system) in 2015, the stations had been in trial operation in different geographical latitudes over a long period of time totaling up to 1.500.000 hours. Precision approach procedures were also published based on this system.

2.2 The joint use of the navigation signal of GPS and GLONASS provides additional benefits associated with the fact that GPS provides better coverage in equatorial latitudes and GLONASS provides better coverage in high latitudes. Besides civil signals from both systems are broadcasted in different bands and different signal separation techniques are used – code division for GPS and frequency division for GLONASS; this increases the noise immunity during the joint use.

2.3 All the GBAS stations installed have coverage of 350 km for the positioning service and 37 km for the landing approach service, category 1, which is in compliance with ICAO requirements (section 7.3, Annex 10, Vol. 1). The whole complex of the stations installed has enabled almost full coverage of air space with the GBAS function. Thus, real time recording of the satellite constellations' condition is currently done for almost the whole air space.

2.4 All GBAS stations represent a data source for the centre of the global satellite constellation condition monitoring and forecast, which is used by airlines and ATM centers when planning flight routes and managing air traffic. Besides, each station is planned to be used as a data source for the national ground-based augmentation system. The formation of this centre has allowed a significant enhancement in the navigation service quality of the global navigation satellite network and provided the possibility of avoiding problem areas; and a wide GBAS network allows considering the dynamics of ionospheric storms and springing up of local radio interference in the work of the navigation system.

2.5 GNSS monitoring has become an integral part of ATM service, because a reliable warning of controllers about possible malfunctions in the operation of the navigation satellite systems is a significant factor of flight safety promotion by state nowadays. It also contributes to the raising of confidence in the operation of navigation satellite systems in air space, as well as complies with ICAO requirements related to GBAS monitoring for the purposes of air accident investigation.

2.6 The airlines performing automatic instrument landing procedure by GBAS, point out the comfort of the system use as well as a more stabilized work of autopilot when performing automatic landing procedures by GLS.

2.7 Given the availability of GBAS at the airports, new landing approach procedures for GLS and RNAV GNSS are to be issued, which would induce a significant enhancement of the regional aviation capacity and traffic capacity of transportation hubs.

2.8 Understanding advantages which airlines would gain as a result of the regional airports' meteorological minimum lowering, many operators have additionally equipped their aircraft with satellite navigation avionics. New aircraft delivered nowadays, are mainly equipped with modern satellite navigation means which enable the use of the GBAS benefits in full.

2.9 The aviation legislation of the member States of the Agreement was also updated in order to enable a full-fledged use of the satellite navigation at all flight stages, including GLS landing approach.

2.10 Besides, close disposition of GBAS on the country's territory creates conditions for the aircraft equipped with GLS systems as per Annex 10 to meet all the PBN requirements with a performance no less than RNP 0.02/40.

### 3. CONCLUSION

3.1 Wide introduction of ground-based national augmentation system for GPS and GLONASS such as GBAS has permitted:

3.2 The member States of the Agreement to resolve the issue of the radio navigation aids modernization using modern aviation systems in the shortest time.

3.3 Accomplishing the modernization of civil aviation fleet by means of modern navigation complexes.

3.4 Laying the foundation for the RNP 0.02/40 implementation at all flight stages within station coverage for the aircraft compatible with GBAS (a D max of 350 km for positioning service).

3.5 Providing a wide network of Rims data sources for the SBAS SDKM system.

3.6 The information presented herein reveals positive trends in the improvement of flight safety as a result of GBAS deployment. The use of the GLONASS/GPS equipment already developed and being manufactured based on air navigation performance (PBN) allows upgrading ground navigation systems as well as optimizing the existing infrastructure in order to get real savings provided that the flight safety performance achieved is maintained or improved.