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WORKING PAPER

ASSEMBLY — 38TH SESSION

TECHNICAL COMMISSION

Agenda Item 33: Air Navigation — Standardization

USE OF THE MULTIPLE CONSTELLATIONS OF THE GLOBAL NAVIGATION SATELLITE SYSTEM FOR AIR NAVIGATION

(Presented by the Russian Federation)

EXECUTIVE SUMMARY

This document addresses aspects of using the global navigation satellite system (GNSS) multiple satellite constellations in air navigation and offers proposals for ICAO to develop a concept for using GNSS in a multi-constellation configuration and a policy for its application.

Action: The Assembly is invited to recommend that the ICAO Council:

a) conduct qualitative and quantitative assessments of the operational advantages obtained from using multiple GNSS constellations, based on information from experience with this particular usage submitted by interested States; and
b) design a concept and policy on issues of using GNSS multiple satellite constellations.

Strategic Objectives:	This working paper relates to the Safety and the Environmental Protection and Sustainable Development of Air Transport Strategic Objectives.
Financial implications:	Funding within ICAO regular programme budget.
References:	Annex 10 — *Aeronautical Telecommunications*, Volume I — *Radio Navigation Aids* Doc 9849 — *Global Navigation Satellite System (GNSS) Manual*

1. INTRODUCTION

1.1 When the global air navigation satellite system (GNSS) was initially put into service in international civil aviation, the conceptual ideas about the joint use of two and more satellite navigation systems as part of GNSS were somewhat preliminary in nature and were not then developed further.

1.2 Today, the situation has changed somewhat, because the GLONASS satellite constellation has been fully restored, significant progress has been achieved in deploying Galileo and BeiDou, and GNSS, already operating, has seen impressive, ongoing technical development. As a result,

[1] Russian version provided by the Russian Federation.

it has become timely and important to resolve issues of how to use the GNSS multiple satellite constellations on a joint basis.

2. BACKGROUND

2.1 The matter of jointly using existing and future GNSS constellations was discussed at the ICAO Twelfth Air Navigation Conference in 2012 (AN-Conf/12). The conference noted the existing potential of the significant operational benefits yielded from the implementation. Those benefits include navigation performance improvements, lower likelihood of loss of service, and decreased GNSS vulnerability. At the same time, the Conference acknowledged the fact that some new technical, standards, and operational problems had emerged, related to the implementation of multi-constellational, multi-band satellite navigation systems.

2.2 The AN-Conf/12 noted that some States might sanction aircraft having equipment to work with a specific GNSS constellation for various reasons that aren't necessarily tied only to navigation performance. For such situations, the Conference drafted an agreed-to opinion that any State that plans to issue such mandates must limit them to the operators of aircraft for which it is the State of the operator. The Russian Federation supports that opinion.

2.3 The Russian Federation also does not intend to introduce any limiting sanctions with respect to the use of GNSS constellations that meet requirements of the ICAO Standards and Recommended Practices in the airspace delegated to her, following Recommendation 6/6, item c), of Presentation AN-Conf12, specifically: “Take a performance-based approach as regards the use of the global navigation satellite system (GNSS), and avoid introducing a prohibition on the use of GNSS elements that meet the requirements of ICAO SARPs”.

2.4 The AN-Conf/12 drew attention to additional challenges that emerge if aviation authorities issue mandates for the use of specific GNSS elements in States. Some States, guided by a sovereign approach to assuring the security of the air navigation service offered in the national airspace, refrain from issuing permits for operations using GNSS elements that are offered to other States for use. So, liability issues may need to be worked out when there is joint use of existing GNSS constellations.

2.5 At the same time, the transition to realizing the benefits of joint use of multiple satellite constellations is feasible and advisable. This, it is expected, will lead to increased accuracy, integrity, readiness and continuity of service when using GNSS, lower GNSS vulnerability and sensitivity to unintentional and intentional interference. The negative impacts of technical and political factors will decrease on using GNSS in world air navigation and experience will be gained in how to use multiple satellite constellations to solve air navigation service tasks on the basis of GNSS.

2.6 In the Russian Federation, there are principles governing actions related to use of multiple satellite constellations. The Appendix attached to this working paper contains these principles.

2.7 We can assume that it's already possible for international air navigation to use satellite constellations in GNSS without impairing operators' rights in other States to use GNSS elements and signals. Meanwhile, an integral condition for ensuring a transition to the use of GNSS multiple satellite constellations in international civil aviation is ICAO developing a concept for this GNSS use with an assessment of the expected benefits and a policy of its application.

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APPENDIX

Some Principle Provisions Informing Actions Relating to Using the Multiple Satellite Constellations in the Russian Federation

1. It is assumed that soon GNSS will be one of the primary navigation services in the airspace of the Russian Federation.
2. The GLONASS grouping achieved its nominal size, 24 satellites, at the end of 2011 They are being used as designed and there are several back-up satellites in the group.
3. There is already the capability to use multiple satellite constellations to solve navigation problems on the basis of standardized elements of GNSS: GPS and GLONASS. There are at least eleven satellites with coverage at any point in the airspace at any time, which greatly improves the GNSS service integrity, readiness, and continuity, and also makes it possible to design new effective algorithms known as Advanced RAIM.
4. The GLONASS grouping belongs to the Russian Federation, and as a result the Russian Federation experiences no difficulties with legal liability for GNSS elements that cannot be controlled by the Russian Federation.
5. The Russian Federation has approved the federal targeted programme “Support, development, and use of GLONASS in 2012 – 2020”, which guarantees budget funding for all work on subsequent support and development of the GLONASS system for the future.
6. By decree of the President of the Russian Federation, Russian and foreign users now have open access to civil navigation signals on a complimentary basis and without limits. The edict specifies the schedule of work in terms of GLONASS support and use and establishes the need for GLONASS's continued development over the long term.
7. By edict of the Russian Federation Government, the course of jointly using GLONASS/GPS groupings has been charted, including in civil aviation.
8. There is significant experience in Russian enterprises designing, producing and certifying GLONASS/GPS receivers of various types for the aviation sector, as well as installing these units in Russian-made civil aircraft. These designs demonstrate the technical interoperability of GNSS satellite constellations, despite the varying signal structures and other features of the systems.
9. Much positive experience has been gained whereby Russian operators have been using GLONASS/GPS-based navigation. This demonstrates the operational advantages from using a dual-system GLONASS/GPS receiver, since RAIM performance improves markedly and there is always the capability of implementing FDE functions in the flight receiver. So, problems with supporting RAIM en-route and near the aerodrome are minimized. In the future, when using a receiver that works with GLONASS and GPS constellations, we will have the advantages of approach procedures with vertical guidance (APV) without using functional add-ons.

10. There is experience of designing dual-system functional add-ons GBAS and the System of Differential Correction and Monitoring (SDCM) (Russian SBAS). Dual-system GBAS are already being installed at airports in the Russian Federation. Studies conducted by Russia and EUROCONTROL show that the GBAS onboard receiver that works only with GPS receives the information it needs (pseudo-range corrections and integrity information only for GPS satellites. So having a dual-system station doesn't cause any problems for GPS onboard equipment in differential mode. In addition, when designing a GBAS prototype for ICAO Category II/III, the requirements for this system are resolved much more easily if dual-system GLONASS/GPS equipment is used.

11. When using the multiple GNSS constellations, the problem of designing and implementing APNT (alternate positioning, navigation, and time) tools is made much easier; the existing VOR and DME fields can be used for these tools.

12. The Russian Federation does not intend to deny service to aircraft equipped only with GPS receivers or in the future with other satellite constellations. Meanwhile, in the Russian Federation it is customary to use both GPS and GLONASS. To record GNSS data pertaining to these constellations the implementation process will have two recording and monitoring stations, each of which monitors GPS and GLONASS parameters. One of the networks is KAS CIDIM, an integrated, automated system to collect and send aviation users information about the monitoring of GNSS signals. It is based on the use of GBAS stations installed at airports in the Russian Federation and designed to be used only for the benefit of civil aviation. Another network is part of the ground segment of the SDCM broad-zone system, which is the implementation of the SBAS system and transmitting changes and information about the integrity of GPS and GLONASS. The data of these networks are used to populate databases, analogous to data collection and recording programmes made when GPS was brought into service and its functional add-ons. Currently, the main server of the KAS CIDIM server is installed in the headquarters of the federal state unitary enterprise “State Corporation for Air Traffic Management” in Moscow. Acceptance testing of the KAS CIDIM has been completed and it is in preliminary operating mode. When it is in nominal operating mode, it will be possible to begin the broad implementation of satellite navigation in the airspace of the Russian Federation. With respect to the SDCM it is expected that it will go into service in 2015.

13. The Russian Federation intends to establish close relationships with producers of aviation equipment with respect to equipping aircraft with GLONASS/GPS receivers and strives for this to garner a positive response.

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