AN-Conf/12-IP/23
10/10/12
English and Russian only[1]

TWELFTH AIR NAVIGATION CONFERENCE

Montréal, 19 to 30 November 2012

Agenda Item 1: Strategic issues that address the challenge of integration, interoperability and harmonization of systems in support of the concept of "One Sky" for international civil aviation

1.1: Global Air Navigation Plan (GANP) – framework for global planning

IMPLEMENTATION OF THE MULTI-CONSTELLATION USE OF GNSS IN THE RUSSIAN FEDERATION

(Presented by the Russian Federation)

EXECUTIVE SUMMARY

In this information paper the data is presented on the establishment of a multi-constellation equipment complex and development of multi-constellation use of GNSS in the Russian Federation.

1. INTRODUCTION

1.1 Nowadays the number of various applications of the global navigation satellite system (GNSS) continues to grow. It was developed under the auspices of ICAO and incorporates operational national global navigation systems GPS and GLONASS, as well as their augmentations. To promising applications of GNSS its multi-constellation use can be attributed, i.e. operation of navigation equipment through navigation signals from two or more navigation satellite systems (which are part of GNSS) simultaneously. In the Russian Federation directive, documents have been adopted where the multi-constellation use of GNSS is stipulated as fundamental use for the civil aviation of the Russian Federation; these documents also specify procedures and time constraints for the equipage of civil aircraft with dual-system GPS/GLONASS satellite navigation equipment.

2. MAIN PROVISIONS

2.1 Peculiarities of the multi-constellation use of GNSS

2.1.1 The multi-constellation use of GNSS has been discussed at the ICAO Navigation Systems Panel meetings many times. The issue on the multi-constellation use was addressed at the ICAO Eleventh Air Navigation Conference. It was highlighted that the use of navigation signals from several systems helps to increase the stability of the whole GNSS through decreasing the vulnerability to unintentional and intentional interference, improving the integrity, reliability and accuracy characteristics of the navigation provision, decreasing possible negative influence of technological and political factors.

[1] English and Russian translation provided by the Russian Federation

2.1.2 The benefits of the multi-constellation use become apparent also due to the large quantity of visible navigation satellites during aircraft evolution and flights under limited sky line visibility due to terrain and/or artificial constructions.

2.1.3 Joint use of the navigation signals 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 the 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.

2.1.4 All the above-mentioned benefits are proved in many studies which incorporate practical aspects of the joint use of fully deployed GPS and GLONASS; results of these activities have been recently published in different sources.

2.1.5 The drawbacks of the multi-constellation use of GNSS are the following: higher complexity of the receiving equipment and avionics algorithms which results in higher cost in comparison with single-constellation use. However, rapid evolution of microelectronics minimizes the difference in price between single-constellation and multi-constellation equipment but all benefits of the latter remain. A good example of this is the development and production of car navigators and smartphones which use GPS/GLONASS navigation – after the development and introduction into service of multi-constellation chips their price dropped to the level of similar single-constellation chips.

2.2 Establishment of multi-constellation GNSS equipment complex in the Russian Federation

2.2.1 Taking into account the above-mentioned substantial benefits of the multi-constellation use of GNSS the establishment of a ***multi-constellation equipment complex*** for civil aviation was set as a target in the Russian Federation; this complex will include user's avionics and ground- and satellite-based augmentation systems (GBAS and SBAS respectively).

2.2.2 A number of Russian and foreign manufacturers have developed samples of joint GLONASS/GPS avionics and after completion of tests and certification of this equipment the mass production of this equipment has been organized. In the Russian Federation only joint type GPS/GLONASS avionics for satellite navigation is produced (i.e. avionics which use only GPS or only GLONASS isn't produced). In the Russian Federation pilot samples of the joint triple-constellation GLONASS/GPS/Galileo avionics are also developed. Its production can be organized when a number of technological problems are solved that associated with the development of the integrated antenna, selection of optimum combinations of navigation signals in use and deployment of Galileo system.

2.2.3 At the time, multi-constellation (MC) GBAS CAT I have been developed, certified and introduced into service in the Russian Federation, which broadcast differential corrections to the pseudo-range (which is measured on board) of the navigation satellites of GLONASS and GPS systems and which provide data on the navigation service integrity (provided by both systems) to aircraft and ATS. Besides these GBAS are used as sensors of the GLONASS and GPS monitoring system, which is now being developed in the Russian Federation. It should be noted that the user can use the data provided by MC GBAS for both systems either jointly or separately (by each system). In this case joint use of the data from GLONASS and GPS systems seems to be preferable with a view to achieve best characteristics of MC GBAS.

2.2.4 On the basis of the above-mentioned MS GBAS CAT I, a prototype of an MC GBAS has been developed within the framework of ICAO SARPs project for GBAS CAT II/III; this prototype station operates with GPS and GLONASS systems and support ICAO CAT II and III landing. This prototype has successfully

passed the flight tests. In this case the use of two navigation systems made the task of providing GBAS required performance easier during the solution of this difficult problem.

2.2.5 In the Russian Federation, a dual-constellation SBAS has been developed that is now at the flight test stage – System for Differential Correction and Monitoring (SDCM), which will provide GLONASS and GPS systems monitoring and will provide GNSS users with differential corrections for navigation satellites of both systems. It is planned that in the future this system will be able to support ICAO CAT I landing.

2.2.6 The use of the developed and produced GLONASS/GPS equipment 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 achieved flight safety performance remains or improves. It can be mainly attributed to landing and terminal stages of the flight where multi-constellation ground and space augmentations can be used in addition to user's multi-constellation onboard navigation equipment.

2.3 Main directive documents of the Russian Federation on the development of the multi-constellation use of GNSS

2.3.1 All activities for establishment and development of the multi-constellation GNSS equipment complex in the Russian Federation have been conducted within the framework of the Federal Investment Programmes "Global navigation system" (valid from 2001 to 2011) and "Support, development and use of the GLONASS system for 2012-2020" (valid at the time).

2.3.2 The main directive document which forms a base for GLONASS and GLONASS/GPS systems' equipment provision to users is a Decree of the Government of the Russian Federation from 2008.

— END —