POSSIBILITIES OF USING THE SBAS SYSTEM ON THE TERRITORY OF SR

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The text is dealing with the possibilities of using technical means of navigation based on global navigation satellite systems for approach and landing under the geographical conditions of the Slovak republic with regard to the current situation of signal coverage by these systems. The article outlines the future of air navigation support and the requirements set for the use of EGNOS system at instrument approach procedures.

K e y w o r d s: airplane approach procedures, satellite navigation operational performance standards, global navigation satellite systems, satellite-based augmentation, wide area augmentation system

1 INTRODUCTION

The near future estimates foresee the termination of operation of current non-autonomous navigation systems and cancellation of ground-based navigation aids such as NDB, VOR, VOR/DME, LORAN C and systems like DME/DME, ILS and MLS as well.

Navigation referred to as RNAV will be based, at all levels, on information from GNSS signals. Precision and reliability of wide area and locally expanding systems will increase within a short period of time in the wake of the introduction of GNSS systems of second generation and the Galileo system as well.

The GNSS systems are integrated into a network of wide-area and locally expanding systems that eliminate deficiencies in terms of precision, integrity, availability and continuity of the signal as the present level of is not sufficient in most of the phases of flight. Current needs, first of all in air traffic, require large area coverage of precise information from satellite navigation systems. Local differential systems are not efficient in this case, therefore, it is of great advantage to use wide area differential systems based on more complex methods of differential measurement, but the network of their ground-based stations is substantially thinner than that of the comparable local differential systems.

2 SBAS SYSTEMS

Services of navigation information support over a large area are currently provided by SBAS systems.
They consist of:

- Ground-based infrastructure,
- GNSS satellites,
- SBAS board receivers.

At the present time, the following wide-area, mutually compatible systems are in operation::

- WAAS (Wide Area Augmentation System) – an American system providing coverage over the territory of the United States of America including Alaska and part of the territory of Mexico,
- CWAAS (Canadian Wide Area Augmentation System) - a Canadian extension of the WAAS system covering Canada's territory,
- EGNOS (European Geostationary Navigation Overlay Service) – a European system with coverage over European states and adjacent except for Russia and Ukraine,
- MSAS /MTSAT (Multi-functional/Transport Satellite Augmentation System) – a Japanese system covering the territory of Japan.

Project stage or prior to entering service are the systems as follows:

- GAGAN (GPS And Geo-Augmented Navigation) - an Indian project based on GPS and GLONASS systems, planned to cover the entire territory of India,
- SNAS (Satellite Navigation Augmentation Service) - a Chinese project for China and Asia.

Interoperability of the individual SBAS systems is ensured in via the application of standards, namely the SARPs and MOPS (Minimum Operational Performance Standards). Development and organization of the time Schedule of standard applications and research in to the effects in terms of security is the responsibility of the ICAO and the RTCA working groups known as the IWG (Interoperability Working Group). In practice, interoperability is to make sure that the board equipment meet the criteria of the latest version of the GPS/WAAS MOPS (DO-229C) and are capable of working with any kind of SBAS signal.

3 EGNOS

The European wide-area satellite system, the EGNOS, is a joint project of the European Space Agency (ESA) and the European Commission (EC and the European organization for air traffic safety, the EUROCONTROL. ESA is responsible for the development, location and technical validation of the system. EC is held accountable for the institutionalization, policies, coordination and implementation of navigation in Europe, as well as for identification of user requirements and financing. The role of the EUROCONTROL is to define the requirements of the civil aviation, perform testing of operational capability and verification its applicability for aviation as well as for safety regulation support.

System configuration

The ground-based segment is made up of:

- 34 (planned amount) ground –based RIMS (Ranging and Integrity Monitoring Stations),
- 4 main (one standby) MCC (Mission/Master Control Centers) – in Spain, UK, Germany and Italy;
- 6 (3 standby) transmitter NLES (Navigation Land Earth Stations) – one main and one standby for each communication satellite;

Communication satellites – the system makes use of:
- 2 satellites of the INMARSAT III communication system:
- AOR-E (Atlantic Ocean Region-East) at the 15.5°wetern longitude over the Atlantic Ocean;
- IOR –W (Indian Ocean Region-West) at the 25°Eastern longitude over Indian Ocean;
- 1 satellite of the ESA ARTEMIS communication system at the 21.5° Eastern longitude over Africa.

The communication satellites are located on a geo-stationary orbit at an altitude of 35,786km transmitting differential correction and information on the integrity of the system for tether entire Europe, with the acceptation of Ukraine and Russia. There exist plans on the extension of the system for the Mediterranean region and the territory of Africa.

The precision of the system is between l-5m in 95% of measurements.

The carrier frequency (1575,42 MHz) modulation and encoding is identical to that of the GPS. Data forma this different as it also contains on corrections and system integrity. Signal specification is defined in RTCA/DO-229C

In 2006, the system was introduced into the pre-operational stage and was integrated into the Galileo project. Thereby, it became part of a program of primary strategic importance for the independence of Europe and comprises a whole range of applications with good prospects.

4 POSSIBILITIES OF USING THE EGNOS ON THE TERRITORY OF SR

The EGNOS system will be an important contribution mostly for smaller airports lacking financially demanding landing systems. The system enables construction of new arrival and departure routes respecting environmental protection and economical requirements in terms of operational costs. Such airport could be utilized even under poor visibility without extra navigation infrastructure.

In the geographic environment of the Slovak republic, making good use of it, the system will enable application of approach procedures on both public and private airports, for which building current landing systems would prove inefficient or even impossible due to their location in a mostly mountainous terrain. It will also be possible to establish a number of heliports (their sizes corresponding to a minimum of a single area of FATO approach or heliport) suitable for non-precision approach of helicopter RNAV and for RNAV approach with vertical guidance over a mountainous terrain with a broken procedure of approach under the condition of low visibility values.

The current status and the requirements set for the utilization of EGNOS at approach procedures on instruments:

The aircraft are to be equipped with on-board instruments capable of cooperation with the EGNOS system (receivers marked as "With WAAS")

Note: The basic requirements and technical specifications of the SBAS airborne navigation equipment are found in ICAO ANNEX 10, Volume I - Radio Navigation Aids and further requirements to specification in RTCA DO - 229C as amended FAA TSO-C145A and TSO-C146A.

When using the system for precision or non-precision approach, it is mandatory to define the availability of a minimum of one communication satellite (AOR-E, IOR – W, ESA ARTEMIS) in the area of approach.

5 CONCLUSION

It is the coverage that is considered one of the decisive factors when using the EGNOS system as within the region with satellite signal coverage available one can define the region where position and navigation services are to be provided with the required level of precision.

Currently, regions of the Slovak republic are found on the boundaries of EGNOS signal coverage. The percentage of coverage is decreasing eastward from 99,8% to 95%. On installation of all the RIMS stations the entire territory will be provided with reliable signal coverage for sure.

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